TRABAJO DE FIN DE GRADO

REALIZAR EJERCICIO FÍSICO MEJORA LA SINTOMATOLOGÍA EN EL SÍNDROME DEL INTESTINO IRRITABLE CON TENDENCIA AL ESTREÑIMIENTO EN LA MUJER

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Año Académico 2020-21

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Palabras clave del trabajo: Ejercicio, intestino irritable, estreñimiento, mujer, dieta

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RESUMEN

Objetivo: comprobar si realizar ejercicio físico mejora la sintomatología en el síndrome de intestino irritable con tendencia al estreñimiento (SII-E) en la mujer. Además, investigar la relación que supone realizar ejercicio físico y hacer una dieta para mejorar la sintomatología del SII-E y los efectos gastrointestinales que estos producen.

Introducción: El síndrome de intestino irritable (SII) es una enfermedad gastrointestinal sin una causa concreta y con una alta prevalencia en mujeres con respecto a los hombres. Hoy en día existe poco conocimiento sobre tratamientos alternativos que puedan sustituir la farmacología para mejorar la sintomatología del SII-E, por lo que este estudio sugiere la actividad física y la dieta como tratamiento alternativo de dicha enfermedad.

Metodología: La búsqueda bibliográfica se realiza a través de las plataformas de bases de datos como son: EBSCOhost, BVS, Pubmed, Medline y Cochrane con sus respectivos límites de los cuales 24 artículos han sido seleccionados para el estudio.

Resultados: En los 24 artículos seleccionados se trata sobre el SII y estreñimiento funcional (EF) en relación con la actividad física, la dieta y los efectos gastrointestinales que se producen.

Conclusión: Se concluye que la actividad física y la dieta producen efectos gastrointestinales positivos en el SII y en el estreñimiento, encontrando mejoras en el tránsito intestinal como es el aumento de la motilidad gastrointestinal, la reducción de dolor abdominal y la hinchazón entre otros. No obstante, se ha constatado que es necesario ampliar la literatura, ante la ausencia de estudios sobre la relación estrecha entre SII con tendencia al estreñimiento, ejercicio físico y dieta.

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INTRODUCCIÓN

El presente trabajo tiene como propósito comprobar si realizar ejercicio físico mejora la sintomatología en el síndrome de intestino irritable con tendencia al estreñimiento (SII-E) en las mujeres. Es un tema de interés ya que es un problema que cada vez afecta a más personas en la sociedad. Merece la pena estudiar dicho tema ya que existe poco conocimiento sobre tratamientos alternativos en el SII-E como la actividad física y que mayormente se trata a través de laxantes y varios fármacos.

El objetivo de este estudio es comprobar si el ejercicio físico puede ser un tratamiento alternativo efectivo en el SII-E y así poder evitar el consumo de medicación como primera herramienta para aliviar y/o mejorar los síntomas.

El SII-E es un subtipo de SII en el que el estreñimiento es la alteración predominante en las deposiciones (1). Se considera que tanto el SII-E como el estreñimiento funcional (EF) son diagnósticos intercambiables en el tiempo por el mismo individuo (1). El estreñimiento funcional se caracteriza por la dificultad o la escasa frecuencia en relación con las deposiciones, a menudo acompañado de esfuerzo excesivo durante la defecación o sensación de evacuación incompleta durante al menos 3 meses (1). El SII se define como una enfermedad gastrointestinal sin una causa concreta (2) y se caracteriza por la presencia de dolor abdominal recurrente asociado a alteraciones del ritmo deposicional, hinchazón y distensión abdominal ya sea de forma de estreñimiento, de diarrea o ambas unas tres veces a la semana, durante 3 y 6 meses (1). Tanto el EF como SII-E tienen similitudes clínicas, pero se les diferencia por la presencia o ausencia de dolor y el tiempo en que persisten los síntomas (1)(3).

Estudios realizados en atención primaria demostraron que los pacientes afectados por ambos trastornos pueden presentar cambios en sus síntomas, pasando de SII-E a EF o viceversa (1). por este motivo el procedimiento terapéutico a través de ejercicio físico puede resultar útil en ambas situaciones.

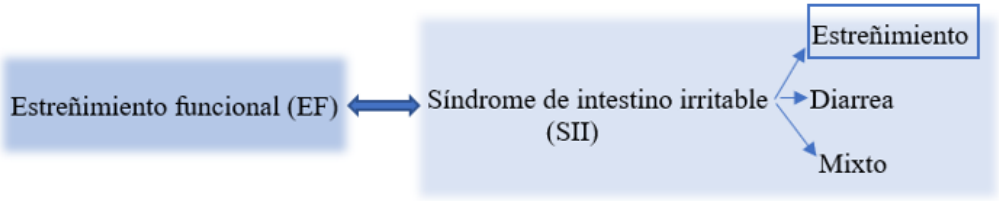


Imagen 1: Esquema bidireccional donde se muestra que pacientes que padecen ambos trastornos pueden presentar cambios en sus síntomas en ambas direcciones.

Las causas más frecuentes que pueden llevar a padecer SII-E son el consumo de fibra inadecuado, la toma de medicación como laxantes, las rutinas inadecuadas o las deposiciones irregulares y finalmente la vida sedentaria(4). Actualmente, la mayoría de los pacientes que acuden a consulta asocian los síntomas a algún alimento que ha provocado la situación (4). Por lo general esta afección se trata inicialmente con la prescripción de laxantes y suplementos de fibra (4). La mayoría de los pacientes quieren evitar la ingesta de medicación por lo que optan por cambiar su estilo de vida, aumentar consumo de fibra y hacer ejercicio físico ya que se ha demostrado que hacer ejercicio estimula el funcionamiento del colon (3)(4)(5)(6).

Para diagnosticar estas alteraciones intestinales descritas anteriormente se utiliza la escala de Criterios ROMA III o IV, y como apoyo complementario se utiliza la escala de Bristol para identificar los diferentes tipos de heces (1) (Ver anexo 1**).**

En diferentes países este problema de estreñimiento está asociado a características de cada población, dependiendo de su formación, cultura, y sociedad (7). Por ejemplo, según los criterios de Roma III se destaca que la población occidental tiene una mayor prevalencia de SII (del 10 al 15%) que la población asiática (del 1 al 10%) (8).

El SII se admite como un problema importante en la salud pública (7) por los costes asociados a esta enfermedad. En EE. UU, 3.5 millones de personas acuden anualmente a consultas médicas por este problema y en Europa, más concretamente en España, también se demuestra el aumento de costes en la sanidad (3). Los pacientes que padecen SII ven como su calidad de vida se ve afectada física, psicológica y económicamente, dado que, produce baja laboral y además de factores personales que pueden influir en la aparición de la enfermedad (8).

En cuanto a género, el SII afecta más a mujeres que a hombres, pudiendo provocar depresión, estrés y trastornos del sueño (2). Puede aparecer en ciertos momentos, como días anteriores a la menstruación, embarazo y cada vez más después de la menopausia (4). Las causas a las que se asocia este problema pueden ser debidos al factor hormonal (progesterona) o a alguna cirugía ginecológica que haya dañado musculatura de suelo pélvico, lesionando los nervios necesarios para la defecación (7).

Se han hecho algunas investigaciones en las que se proponen programas de ejercicio físico ya que al hacerlo puede disminuir el estreñimiento, aunque también hay estudios que demuestran que hacer ejercicio físico puede ayudar a mejorar la calidad de vida de los pacientes afectados por este trastorno, pero no pueden aliviar los síntomas (9).

La falta de diagnóstico y por tanto la falta de tratamiento en el SII y EF, puede llegar a tener graves consecuencias, sobre todo, en la población anciana ya que son incapaces de evacuar gran cantidad de heces endurecidas en el colon debido al bajo consumo de fibra y al poco ejercicio físico(10).

Esto también conlleva a que los pacientes tengan una mala calidad de vida asociada a este trastorno, con problemas psicológicos como depresión, trastornos del sueño, o incluso un aumento en la probabilidad de sufrir cáncer de colon (9).

A través de los resultados obtenidos se constata que, si bien el ejercicio de actividad física es bueno para la salud en general, otros datos sugieren que la relación de actividad física con el SII (11) no siempre ayuda, dependiendo del tipo de ejercicio que se realice (9).

También hay cierto debate con la ingesta de fibra en estos pacientes ya que a veces no es beneficiosa y puede agravar los síntomas del SII (6), por lo que con estos estudios se pretende averiguar si existe un tipo de dieta en pacientes con SII que ayuden a mejorar el malestar gastrointestinal.

OBJETIVOS

Objetivo general:

- Comprobar si realizar ejercicio físico mejora la sintomatología del SII-E en las mujeres.

Objetivos específicos:

- Investigar la relación que supone realizar ejercicio físico y hacer una dieta para mejorar la sintomatología del SII-E en las mujeres.
- Describir los efectos gastrointestinales que produce el ejercicio físico y la dieta sobre las mujeres que sufren SII-E.

METODOLOGÍA

1. Estrategia de búsqueda bibliográfica

La búsqueda bibliográfica se realizó con el objetivo de comprobar la posible mejora de la sintomatología en el síndrome del intestino irritable con tendencia al estreñimiento en la mujer mediante la realización de ejercicio físico.

Para definir las estrategias y los criterios de búsqueda, se han seguido las siguientes recomendaciones:

1. Temporalización de la búsqueda durante los meses de marzo y abril, usando como bases de datos de referencia los metabuscadores EBSCOhost y BVS; Base de datos específicas como PubMed y Medline, finalmente, en bases de datos de revisiones como Cochrane.
2. Se han realizado búsquedas específicas por palabras clave, como las que se exponen a continuación:

- Ejercicio
- Actividad física
- Intestino Irritable
- Estreñimiento
- Mujer-Femenino
- Dieta-Nutrición
- Efectos gastrointestinales

Los descriptores anteriormente descritos fueron utilizados también para poder realizar la indización del contenido, además de usar un lenguaje único para facilitar la consulta de artículos y la revisión bibliográfica. El objetivo en último término es poder consultar aquellas publicaciones con una temática u hipótesis de investigación que pueda ayudar a resolver la pregunta planteada. Para ello, se ha utilizado la plataforma DeCS, a partir de la cual se pudo llevar a cabo la traducción de las publicaciones en inglés. A continuación, se muestran los principales resultados:

- Exercise
- Physical activity
- Irritable bowel
- Constipation
- Women - Female
- Diet – nutrition
- Gastrointestinal effects

Se han realizado también combinaciones con el booleano AND; entre los descriptores utilizados en el presente estudio se incorporó el booleano OR.

2. **Estrategia de búsqueda de las diferentes bases de datos:**

METABUSCADORES
EBSCohost
Primer nivel: (exercise OR physical activity) AND (irritable bowel OR constipation) AND (women OR female). **Segundo nivel:** (exercise OR physical activity) AND (irritable bowel OR constipation) AND (women OR female) AND (diet or nutrition). **Tercer nivel:** (exercise OR physical activity) AND (irritable bowel OR constipation) AND (women OR female) AND (diet OR nutrition) AND (gastrointestinal effects).
Biblioteca virtual de salud (BVS)
Primer nivel: (exercise OR physical activity) AND (irritable bowel OR constipation) AND (women OR female). **Segundo nivel:** (exercise OR physical activity) AND (irritable bowel OR constipation) AND (women OR female) AND (diet or nutrition). **Tercer nivel:** (exercise OR physical activity) AND (irritable bowel OR constipation) AND (women OR female) AND (diet OR nutrition) AND (gastrointestinal effects).
BADE DE DATOS ESPECÍFICOS
Pubmed
Primer nivel: (exercise OR physical activity) AND (irritable bowel OR constipation) AND (women OR female). **Segundo nivel:** (exercise OR physical activity) AND (irritable bowel OR constipation) AND (women OR female) AND (diet or nutrition). **Tercer nivel:** (exercise OR physical activity) AND (irritable bowel OR constipation) AND (women OR female) AND (diet OR nutrition) AND (gastrointestinal effects).
Medline
Primer nivel: (exercise OR physical activity) AND (irritable bowel OR constipation) AND (women OR female). **Segundo nivel:** (exercise OR physical activity) AND (irritable bowel OR constipation) AND (women OR female) AND (diet or nutrition). **Tercer nivel:** (exercise OR physical activity) AND (irritable bowel OR constipation) AND (women OR female) AND (diet OR nutrition) AND (gastrointestinal effects).
BASE DE DATOS DE REVISIONES

Cochrane
Primer nivel: (exercise OR physical activity) AND (irritable bowel OR constipation) AND (women OR female). **Segundo nivel:** (exercise OR physical activity) AND (irritable bowel OR constipation) AND (women OR female) AND (diet or nutrition). **Tercer nivel:** (exercise OR physical activity) AND (irritable bowel OR constipation) AND (women OR female) AND (diet OR nutrition) AND (gastrointestinal effects).

3. Límites establecidos

Bases de datos	límites
Ebscohost (Discovery services)	➢ Buscar todos mis términos de búsqueda ➢ Aplicar palabras seleccionadas ➢ Texto completo ➢ 5 años
BVS	➢ 5 años ➢ Texto completo ➢ Inglés y español ➢ Síndrome de colon irritable
Pubmed	➢ 5 años

Medline	Primer nivel: ➢ 5 años/female/irritable bowel syndrome/ exercise/adolescent/adult/young adult/risk factors/treatment outcome Segundo nivel: ➢ 5 años/female/adult/irritable bowel syndrome/adolescent/diet/feeding behaviour/risk factors/dietary fiber.
Cochrane	➢ 5 años

4. Criterios de inclusión y exclusión.

Los criterios de inclusión considerados han sido los siguientes:

- Investigaciones que recopilen información sobre la población de mujeres que se encuentren entre las etapas de la adolescencia, la edad adulta y la edad avanzada con síndrome de intestino irritable y/o estreñimiento.
- Publicaciones que recopilen información sobre los efectos que provoca el síndrome de intestino irritable y/o estreñimiento tanto a mujeres como a hombres.
- Investigaciones que relacionen el síndrome de intestino irritable y/o estreñimiento con el ejercicio, la dieta o ambos juntos.

Los criterios de exclusión considerados han sido los siguientes:

- Investigaciones que hablen sobre el Síndrome de intestino irritable con tendencia a la diarrea/descomposición porque no aportaba valor a mi investigación.
- Investigaciones que incluyan la población con patología metabólica, cardiovascular o psíquica.
- Publicaciones que relacionen SII con farmacología, por ejemplo, laxantes.
- Investigaciones sobre mujeres en etapa gestacional y postparto.

RESULTADOS

En la revisión bibliográfica se siguió una misma estrategia para todas las bases de datos a través de los metabuscadores, bases de datos específicas y en bases de datos de revisiones, en todas ellas se tuvo en común la temporalización ajustada a los 5 años y, dependiendo de la base de datos se pudo refinar más los límites mencionados en el diagrama de flujo.

En cada base de datos se utilizaron los mismos descriptores con sus respectivos booleanos para buscar los artículos en cada nivel:

- **1er Nivel:** (exercise or physical activity) AND (irritable bowel or constipation) AND (women or female).
- **2do Nivel:** (exercise or physical activity) AND (irritable bowel or constipation) AND (women or female) AND (diet or nutrition).
- **3er Nivel:** (exercise or physical activity) AND (irritable bowel or constipation) AND (women or female) AND (diet or nutrition) AND (gastrointestinal effects).

Al inicio de las búsquedas se realizó una selección de artículos a través de los títulos, resúmenes y conclusiones que mencionaban los objetivos planteados del estudio.

Los artículos seleccionados se escogieron principalmente por las muestras de población que hacían referencia a mujeres o había comparación entre la prevalencia entre hombres y mujeres diagnosticados o no de Síndrome de intestino irritable o estreñimiento. Dentro de estos se abre un amplio rango de edad en que la población estudiada tienen una media de entre 16-79 años con o sin diagnóstico de SII o EF en que las intervenciones de los estudios seleccionados incluyen diversidad de estrategias para abordar la sintomatología y que dentro de ellos se encontraba el ejercicio físico, alimentación y efectos que se producen.

De estos estudios, cabe destacar:

- 4 artículos centran sus estudios en una población diana específica, en este caso, mujeres adultas con un rango de edad que fluctúa entre los 18 años y los 65 años.
- 3 de estos artículos se centran en estudiantes universitarios (de 18 a 25 años), independientemente del género o condición física de los participantes.
- 11 de los estudios se realizan sobre población general, donde se incluyen pacientes de género masculino con un rango de edad que oscila entre los 18 y 78 años.

- 2 estudios específicos sobre atletas, la mayor parte de los participantes de dichos estudios fueron mujeres.
- 4 artículos en los cuales se define SII, SII-E, estreñimiento funcional, factores de riesgo e intervenciones.

La estrategia de búsqueda bibliográfica se inició a través de los metabuscadores: Ebscohost y BVS. Las búsquedas en dichas plataformas fueron dónde más artículos se obtuvieron para realizar la revisión.

Se comenzó en Ebscohost, entre los tres niveles se obtuvieron un total de 402 artículos de los cuales 340 fueron descartados y finalmente 15 fueron escogidos para realizar la revisión.

A continuación, se explica cómo ha sido la selección de artículos en cada nivel:

- **1er Nivel, total:** 308 artículos de los cuales se escogieron 13 ya que los estudios relacionaban el SII o EF con ejercicio físico o cambios sobre la calidad de vida donde se incluía el ejercicio físico, entre ellos se escogieron 6 estudios observacionales, 2 estudios cualitativos, 1 estudio piloto, 3 ensayos clínicos y 1 estudio de casos y controles. Por dificultades de acceso y por duplicación se descartaron 22 artículos. Un total de 295 artículos fueron excluidos por las palabras clave que incluían dichos artículos y en sus resúmenes no se relacionaba el ejercicio físico con SII en mujeres donde su estado de salud entraba dentro de la normalidad.
- **2do Nivel, total:** 77 artículos de los cuales 2 fueron escogidos, 1 diseño experimental en el que se comparan dos tipos de dieta empleadas en mujeres con SII y 1 artículo de revista en el describe la afectación del SII y una dieta específica. Se descartaron 18 artículos por duplicación e inaccesibilidad y 55 artículos fueron descartados ya que las dietas mencionadas no iban dirigidas al tratamiento del SII o EF.
- **3er Nivel**, **total:** 17 artículos de los cuales 3 se descartaron porque trataban de aspectos bioquímicos. También se descartaron 8 artículos ya que se obtuvieron con las búsquedas anteriores y para finalizar, 6 artículos no pudieron ser seleccionados por déficit de acceso.

En BVS se pudo refinar más los límites, así pues, entre los 3 niveles se encontraron un total de 99 resultados. Una vez interpretados los títulos y resúmenes sólo se reclutaron 5 artículos para poder seguir con el estudio.

- **1er Nivel, total:** 79 artículos de los cuales 5 fueron escogidos por la descripción de las conclusiones, de éstos se seleccionó 1 artículo observacional, abordaba la epidemiologia entre hombres y mujeres y factores de riesgo donde incluían la actividad física y alimentación. Se excluyeron 13 artículos por falta de alcance y reiteración y 61 artículos fueron rechazados porque no incluían la población deseada, enfermedades metabólicas y psíquicas.
- **2do Nivel, total:** 15 artículos de los cuales 2 ensayos controlados aleatorios fueron de interés ya que trataban los efectos de las diferentes ingestas de alimentos sobre el organismo en adultos y deportistas con SII o EF, las diferencias y semejanzas sobre el SII o EF y la importancia social. 5 de los artículos fueron de difícil acceso y estaban duplicados. 7 fueron eliminados en la selección ya que trataban sobre población pediátrica mayoritariamente.
- **3er Nivel, total:** 5 artículos, de los cuales se escogieron 2 artículos, se trata de un metaanálisis que define SII-E y EF, la importancia social y económica y el tratamiento a través de cambios de estilo de vida y alimentación. 4 de los restantes artículos no relacionaban el SII-E sino otras enfermedades gastrointestinales.

Para seguir, se utilizaron las bases de datos específicas como son Pubmed y Medline.

En Pubmed, entre los tres niveles se obtuvo un total de 261 artículos, de los cuales 3 fueron seleccionados para continuar el estudio.

- **1er Nivel, total:** 180 artículos de éstos 2 artículos fueron reclutados, por un lado, se escogió 1 artículo de revisión sistemática y metaanálisis en el que compara ejercicio aeróbico y anaeróbico relacionado con SII, por otro lado, 1 estudio observacional que menciona la prevalencia de SII en mujeres relacionados con la edad. 18 artículos estaban duplicados o de difícil acceso y se suprimieron 157 artículos en los que no trataban del SII-E, las muestras eran dirigidas a población infantil o enfermedades metabólicas.
- **2do Nivel, total:** 64 artículos de los cuales se escogió 1 artículo de casos y controles, se exponen resultados sobre la calidad de vida, alimentación y los síntomas sobre los cuatro tipos de SII. 10 de los artículos ya se obtuvieron de la búsqueda en BVS. 7 artículos no se tuvo acceso libre y 47 artículos fueron

descartados al no interpretar resultados relacionados con nutrición y la muestra en mujeres incluidas en criterios de inclusión.

- **3er Nivel, total:** 17 resultados de los cuales no se escogió ningún artículo debido a que 7 de ellos ya se habían obtenido en anteriores búsquedas. En 2 artículos no se tuvo acceso y 8 no se escogieron debido a que la explicación que relacionaban los efectos gastrointestinales se basaba en farmacología o bioquímica.

En Medline se introdujeron límites permitidos en la plataforma. Se obtuvo un total de 98 artículos. Sólo 1 artículo fue escogido.

- **1er Nivel, total:** 77 artículos de los cuales ningún artículo se escogió puesto que 9 de ellos ya se obtuvieron en búsquedas anteriores. En 1 artículo no se tuvo acceso y 67 fueron descartados por no relacionar la muestra de mujeres con SII-E y ejercicio.
- **2do Nivel, total:** 17 artículos de los cuales ninguno fue de nuestro interés ya que no relacionaban el SII-E o EF con ingesta de alimentos y actividad física. 2 artículos ya se obtuvieron de búsquedas anteriores.
- **3er Nivel, total:** 5 artículos de los cuales sólo 1 artículo de casos y controles relacionaba el SII en mujeres adolescentes y la atención multidisciplinar que conlleva.

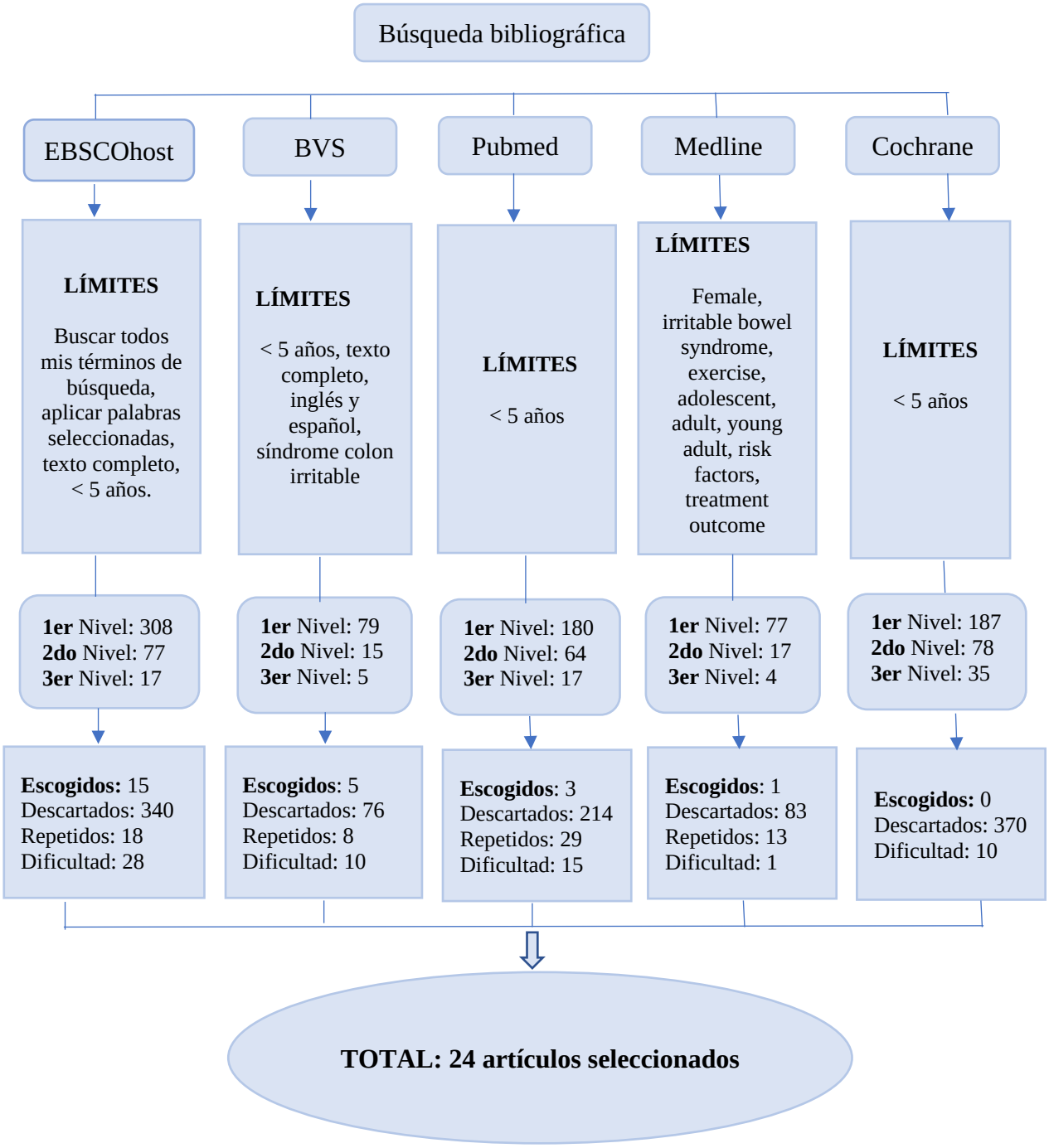
Por último, se realizó la estrategia en la base de datos de revisiones Cochrane, utilizando los límites que permitía la plataforma.

- **1er Nivel:** Un total de 5 revisiones sistemáticas se encontraron, pero tanto el título como los resúmenes no enlazaban el SII-E con actividad física. también se obtuvieron 282 ensayos clínicos de los cuales 8 ya se adquirieron en búsquedas anteriores. 9 artículos no se tuvo acceso y 265 se apartaron del estudio porque no se ajustaban a los criterios de inclusión.
- **2do Nivel, total:** 78 ensayos clínicos de los cuales 3 ya se consiguieron en búsquedas anteriores y en 1 de ellos no se pudo tener acceso.
- **3er Nivel, total:** 35 ensayos clínicos de los cuales 4 ya se eligieron en anteriores búsquedas y 31 artículos fueron descartados al relacionar el SII con biología, genética y enfermedades mentales.

Tabla pico (ver anexo 3).

Fichas de revisión sistemática (ver anexo 4).

Diagrama de flujo



DISCUSIÓN

A continuación, se exponen los resultados obtenidos de cada artículo previamente seleccionado tal y como se ha explicado en el apartado anterior. Se quiere comprobar si la práctica regular de ejercicio físico y realizar una dieta podría llegar a mejorar la sintomatología característica del síndrome de intestino irritable con tendencia al estreñimiento en mujeres.

Para poder entender los resultados obtenidos, se debe considerar que los estudios alcanzados tratan la actividad física y dieta como tratamiento alternativo en el estreñimiento y en el SII abarcando todos sus tipos y sin concretar el tratamiento hacia el estreñimiento.

Se ha observado cada estudio en conjunto y determinando las implicaciones que tanto la actividad física como la dieta podrían tener sobre esta patología, así pues, los resultados obtenidos se han dividido en los siguientes apartados.

- Eficacia de la actividad física sobre la mejora de la sintomatología en el SII y efectos gastrointestinales que se producen.
- Relación entre realizar ejercicio físico y hacer una dieta para la mejora de la sintomatología en el SII y efectos gastrointestinales que se producen.
    - Efectos gastrointestinales al realizar ejercicio físico y Dieta FODMAP

1. Eficacia de la actividad física sobre la mejora de la sintomatología en el SII y efectos gastrointestinales.

Con respecto a la eficacia de la actividad física, y más concretamente caminar, sobre la mejora de la sintomatología en el SII y sus efectos, las investigaciones de los autores Hamaguchi et al. y Shahabi et al. coinciden en la relación positiva sobre el número de pasos y los efectos beneficiosos que se producen en la sintomatología de SII (5)(12) concluyendo que a mayor cantidad de pasos menos probabilidad se tiende a padecer SII. Además, Shahabi et al. compara los efectos de caminar versus yoga y afirma que caminar tiene un impacto más significativo en el estado de ánimo, mejorando la ansiedad, adherencia por la autorregulación y el alivio de los síntomas generales del SII, en cambio, la práctica de yoga tiene un impacto más significativo a nivel de los síntomas más específicos (12).

Otros autores como Fani et al., Melaki et al. y Gao et al. coinciden en la efectividad que tiene realizar ejercicio aeróbico sobre la sintomatología en el SII (13)(14) y en el estreñimiento (9). Fani et al. consideran que es necesaria una intervención de ejercicio aeróbico un mínimo de 25min y 3 veces a la semana para que mejore la sintomatología en SII (13) mientras que para Gao et al. es necesario la práctica de ejercicio aeróbico de manera diaria (9). Estos autores demuestran que realizar ejercicio tiene efectos sobre la motilidad intestinal, el cual el transito gastrointestinal se acelera, aumentando la estimulación de los músculos abdominales para ayudar a que las heces se muevan por el recto (9). Por su parte, Maleki et al. con una línea de investigación similar a los autores anteriores aportan que además de mejorar la sintomatología del SII, los biomarcadores antiinflamatorios y antioxidantes mostraron resultados óptimos a nivel celular mejorando la motilidad (14)(9), permeabilidad y sensibilidad intestinal consiguiendo así una disminución del dolor y distensión abdominal (9).

No realizar ejercicio físico como hábito incrementa la probabilidad de padecer SII (11) (15) con un 27% (11) según Mehdi et al. y Johannesson et al. Por lo tanto, realizar actividad física sería un método adecuado para combatir los síntomas ya que mejora la percepción de salud y aumenta la autoestima de las personas (15)(12). No obstante, el tratamiento propuesto no tiene los efectos descritos anteriormente en aquellas personas que tengan SII con predominio de diarrea ya que ésta acelera el tránsito colónico (15).
En lo que respecta la prevalencia y factores de riesgo asociados al estreñimiento y al SII con la actividad física en la mujer. Chatila et al. y Kouamé et al. estimaron la prevalencia de padecer estreñimiento o SII en mujeres en comparación a los hombres considerando el principal motivo el componente cultural, concretamente oriente, donde la mujer no realiza la misma cantidad de actividad física que el hombre (16) (17). Moezi et al. también considera el componente cultural como motivo de padecer estreñimiento debido a que el estilo de ir al aseo iraní “flexión completa de cadera” es mucho más amplio que en aseo europeo (18).

Siguiendo una perspectiva diferente los autores Yurtdas et al., Huang et al. y Iftikhar et al. achacaron la alta prevalencia a las hormonas sexuales femeninas en las mujeres ya que la progesterona puede prolongar el tiempo de tránsito colónico y esto puede conducir a mayor tasa de estreñimiento (18)(19). Otro factor de riesgo es el incremento de la edad en las mujeres ya que en el periodo premenopáusico las fluctuaciones hormonales son

mayores. También tiene efectos negativos sobre las lesiones en el suelo pélvico debido a un trauma obstétrico durante el parto (19)(7).

2. Relación entre realizar actividad física y dieta sobre la mejora de la sintomatología en el SII y los efectos gastrointestinales.

Existe discrepancia entre los autores por la asociación directa entre actividad física y dieta y la mejora de la sintomatología en SII. Mehdi et al. asociaron que entre los individuos con actividad física sedentaria tenían un 35% más de probabilidades de padecer SII que los participantes físicamente activos, en cambio, no hubo asociación con los hábitos dietéticos (11). Resultados contrarios son los que muestran Mendonza et al., asociando que el consumo de algunos alimentos ricos en carbohidratos altamente fermentables en el intestino puede agravar lo síntomas gastrointestinales del SII, y por el contrario no hubo ninguna asociación significativa con la realización de actividad física (16). A diferencia de los dos autores anteriores, Yilmaz et al. muestran que el aumento de prevalencia de padecer SII puede atribuirse a personas físicamente inactivos y a hábitos alimenticios inapropiados. Además, suponen que las diferencias entre autores vienen motivada por sus culturas y hábitos dietéticos (20).

Con respecto al estreñimiento, Yurtdas et al., Haung et al., Falcón et al. y Moezi et al. coinciden en la asociación existente sobre la prevalencia que se produce entre actividad física y la dieta basada en fibra con el hecho de padecer estreñimiento o SII. Hay que destacar el enfoque de diferentes autores para llegar a la conclusión mencionada: por un lado, Yurtdas et al. y Elhosseiny et al. atribuyen la prevalencia de SII a la inactividad física, la baja ingesta de fibra y el bajo consumo de agua(8). Yurtdas et al. realzan la importancia del ejercicio físico para disminuir los síntomas de estreñimiento al observar mediante su estudio que el grupo activo tuvo un 13’9% de probabilidad de sufrir estreñimiento en comparación con el grupo sedentario con un 20’6% (7). Según Huang et al. y Iftikhar et al. los factores de riesgo asociados al SII para población adulta son dieta a base de carne(19), poco ejercicio físico, estrés y una mala calidad de sueño siendo estos dos últimos un posible desencadenante de trastornos mentales como la ansiedad, la depresión y el insomnio (19)(8)(2). Lo más destacable de estos últimos autores es que se

describe el estrés psicológico o emocional como un factor de riesgo importante el cual puede desencadenar un SII.

Por otro lado, los autores Falcón et al., Moezi et al. y Mendoza et al. apuntan como factor de agravamiento de los síntomas de estreñimiento el bajo consumo de fibra, la baja actividad física y el consumo de AINES. Aunque si es cierto que Moezi et al. concluyeron que especialmente el consumo de opio y antidepresivos puede causar un aumento en la prevalencia del estreñimiento ya que los fármacos provocan disminución de la motilidad intestinal y del agua aumentando a la reabsorción de las heces lo que provoca que seas heces duras(18). Por ello es recomendable aumentar el consumo de fibra ya que al absorber el agua hace que las heces sean más blandas, pasan al recto sin problema y estimulan el movimiento del colon, esto junto con el aumento de la actividad física estimula el movimiento en el intestino grueso (7).

Ha sido revelador descubrir las consecuencias que puede llegar a producir el estreñimiento, como bien explican Falcón et al. el estreñimiento crónico funcional es un riesgo para tener impactación fecal, aunque es necesario otros estudios necesarios para confirmar los factores asociados(10). El estreñimiento crónico (CC) puede causar impactación fecal en cualquier nivel del colon debido a la afectación de la motilidad, viéndose afectada con mayor facilidad en la población anciana(10).

2.1 Efectos gastrointestinales relacionados con la actividad física y dieta FODMAP

El consumo de algunos alimentos puede agravar síntomas gastrointestinales del SII (6). La dieta FODMAP se basa en carbohidratos altamente fermentables que se absorben mal en el intestino provocando síntomas como dolor inferior del abdomen, distensión abdominal, flatulencias y a veces diarrea (6)(21). Aunque también hay que tener en cuenta que los FODMAP son alimentos importantes que proporcionan probióticos, aumentando la población microbiana buena que promueve al aumento de volumen de las heces, con una mejor absorción de micronutrientes y sobre todo muestran una buena función inmunológica que nos ayuda a tener una buena calidad de vida tanto física como psicológica (21).

Los autores Eswaran et al., Wiffin et al. y Lis et al. hacen referencia a los efectos que conlleva realizar una dieta baja en FODMAP (L-FOD) y practicar ejercicio físico en

pacientes que sufren molestias gastrointestinales que provoca el SII. L-FOD es una dieta sin gluten con bajo contenido en hidratos de carbono fermentables (22). Los estudios se llevan a cabo discriminado dos tipos de poblaciones: atletas y población general.

Se puede afirmar que a corto plazo la dieta L-FOD y realizar ejercicio conlleva a beneficios en los síntomas gastrointestinales relacionados con el ejercicio, específicamente en atletas (22)(23). Wiffin et al, por su parte añade que además de mejorar los síntomas, los pacientes percibieron mejoras en la intensidad y frecuencia del ejercicio (23).

Al contrario, si nos atenemos a los resultados de investigaciones sobre la población general, el criterio de Eswaran et al. la dieta L-FOD mejora la hinchazón, el dolor, la consistencia y frecuencia en las heces, aunque se matiza que la dieta L-FOD es efectiva hacia la intervención para pacientes con SII con tendencia a la diarrea (21). Sería necesario realizar estudios donde se pueda observar específicamente resultados de L-FOD sobre el SII con tendencia al estreñimiento.

3. Otras consideraciones:

El estudio se ha realizado desde una perspectiva profesional sanitaria con el objetivo de proporcionar una posible intervención a través del ejercicio físico y hábitos nutricionales que mejore la sintomatología de los pacientes con SII-E. Se podrá apreciar la perspectiva de género en la intervención dirigida hacia la mujer, ya que como se ha observado en el estudio es la población más afectada por esta enfermedad. El ámbito de aplicación sería ideal en centros de atención primaria porque es al primer lugar donde acude el paciente, el más cercano. Además, al profesional sanitario se le dotaría de un espacio adecuado en el que se podría trabajar de manera interdisciplinar entre todo el personal sanitario necesario: médicos, enfermeras, fisioterapeutas especializados en suelo pélvico (24) y nutricionistas que sean capaces de prestar un servicio sanitario óptimo proporcionando información sobre los beneficios que aporta la realización de ejercicio físico y seguir buenos hábitos alimentarios. De esta manera aquellos pacientes que padecen de SII solucionarían definitivamente la afección evitando que pueda pasar de SII a estreñimiento, y viceversa.

Falta información relevante sobre la relación entre ejercicio físico y el SII con tendencia al estreñimiento. Hay una cierta incertidumbre sobre las formas, duraciones o

intensidades a la hora de practicar ejercicios que deban ser capaces de aportar un beneficio a la sintomatología SII-E. Sin embargo, también se han visto muchos factores condicionantes de la enfermedad como puede ser el sexo, la actividad física, los hábitos alimentarios, la ingesta de medicamentos y elementos psicológicos (2).

Gracias a la revisión bibliográfica se ha obtenido información relevante que debe ser tenida en cuenta, es decir, los resultados muestran como el paciente saldría beneficiado al reducir el tiempo de espera para ser atendido, y en consecuencia disminuyendo así la sintomatología SII, y mejorando su calidad de vida. De cara a la práctica clínica, y siguiendo en los beneficios para los pacientes, realizar la intervención a través ejercicio físico junto con buenos hábitos nutricionales puede mejorar la sintomatología en el SII o estreñimiento. Por otro lado, el sistema de salud también se beneficiaría, la ventaja es que dicha intervención se puede tratar en atención primaria, de esta manera se evitaría el colapso en la unidad hospitalaria de gastroenterología y pruebas complementarias costosas, por lo tanto, supondría menor coste sanitario y una mejor atención al paciente.

Muchos de los autores anteriormente mencionados no sólo dirigen los resultados a nivel intestinal, sino también a nivel extraintestinal afectando a la parte psicoemocional en pacientes con SII o estreñimiento. Ejemplo de ello podría ser la depresión o la ansiedad. Lo más destacable de algunos estudios es que en la mayoría se describe el estrés psicológico o emocional como un factor de riesgo importante de padecer SII y no como una consecuencia (12) (14). Hoy por hoy, se menciona al tracto gastrointestinal como el segundo cerebro, por lo tanto, cabe pensar que factores emocionales, psicológicos y comportamentales podrían aportar un claro beneficio en estos casos.

Por la poca concordancia entre los estudios, sería útil continuar con las líneas de investigación que plantean una posible sinergia entre el eje cerebro-intestino y, si la actividad física puede influir en esta relación. Tal y como mencionan algunos autores, la actividad física puede influir favorablemente en la plasticidad cerebral al facilitar procesos neurodegenerativos, neuroadaptativos y neuroprotectores (5). Es decir, valdría la pena realizar estudios en los que se establezcan las causas exactas que provocan el SII. Hasta la actualidad solo se han obtenido hipótesis en las que no se sabe si existe sensibilidad del intestino debido a neurotransmisores alterados; o debido al crecimiento de bacterias en el intestino delgado (12) provocando alteraciones sintomáticas.

Los resultados obtenidos en el estudio han sido contestados parcialmente, se ha podido determinar de manera ambigua que la actividad física es una alternativa de tratamiento para el SII, pero no se puede inferir que esté directamente relacionada con el estreñimiento. Una de las limitaciones que se ha tenido ha sido la falta de especificidad sobre el tratamiento del SII-E. Los artículos hacen referencia al tratamiento del SII abarcando todos los tipos (estreñimiento, diarrea o mixto). Finalmente, se debe mencionar la dificultad en la obtención de estudios de ensayos clínicos, siendo los estudios observacionales los más frecuentes y recurrentes.

CONCLUSIONES

Se puede concluir que la actividad física y la dieta provocan efectos gastrointestinales positivos, en el SII y en el estreñimiento, encontrando mejoras en el tránsito intestinal como es el aumento de la motilidad intestinal, reducción de dolor abdominal e hinchazón. No obstante, se ha constatado que es necesario ampliar la literatura, ante la ausencia de estudios, sobre la relación estrecha entre SII con tendencia al estreñimiento, ejercicio físico y dieta.

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ANEXOS

Anexo 1. Escalas

1.1 Criterio de Roma III y IV

Los **criterios de Roma III o IV** se utilizan para diagnosticar los síntomas del SII, que incluyen dolor o malestar abdominal recurrente, 3 días al mes en los últimos 3 meses (12 semanas), y están asociados con dos o más de los siguientes tres criterios:

1) mejoría con la defecación
2) El inicio está asociado con un cambio en la frecuencia de las deposiciones.
3) El inicio está asociado con un cambio en la forma de las heces (apariencia).

Para cumplir con los criterios, la aparición de los síntomas debe ocurrir 6 meses antes al diagnóstico.

Tabla 1 Criterios* de Roma IV para el diagnóstico de síndrome del intestino irritable con predominio estreñimiento

Dolor abdominal recurrente, como media, al menos un día a la semana en los últimos tres meses relacionado con dos o más de los siguientes criterios: Se relaciona con la defecación Se asocia a un cambio en la frecuencia de las deposiciones Se asocia a un cambio en la forma (apariencia) de las deposiciones En el *SII con predominio de estreñimiento* más de un 25% de las deposiciones con heces tipo 1 o 2 de Bristol y menos del 25% con heces tipo 6 o 7 de Bristol (el paciente refiere que sus deposiciones alteradas son habitualmente como estreñimiento). El hábito intestinal predominante se basa en la forma de las heces en los días con al menos una deposición alterada. El predominio de estreñimiento solo puede ser establecido con seguridad cuando el paciente es evaluado sin tomar medicación para tratar alteraciones del hábito intestinal.

Fuente: Lacy et al.[3].

* Los criterios deben cumplirse al menos durante los últimos tres meses y los síntomas deben haberse iniciado como mínimo 6 meses antes del diagnóstico.

2.1 Escala de Bristol

Anexo 2. Estrategia de búsqueda bibliográfica.

<table>
<tr><th colspan="4">Estrategia de búsqueda bibliográfica</th></tr>
<tr><td>Pregunta de Investigación</td><td colspan="3">¿Realizar ejercicio físico mejora la sintomatología en el síndrome de intestino irritable con tendencia al estreñimiento en la mujer?</td></tr>
<tr><td>Objetivos</td><td colspan="3">- General: comprobar si realizar ejercicio físico mejora la sintomatología en el síndrome de intestino irritable con tendencia al estreñimiento en la mujer

- Específico 1: Investigar la relación que supone realizar ejercicio físico hacer una dieta para mejorar la sintomatología del estreñimiento.

- Específico 2: Describir los efectos gastrointestinales que produce el ejercicio físico y dieta sobre las mujeres que sufren síndrome de intestino irritable con tendencia al estreñimiento.</td></tr>
<tr><td>Palabras Clave</td><td colspan="3">Exercise, physical activity, irritable bowel, constipation, women, female, diet, nutrition, gastrointestinal effects.</td></tr>
<tr><td>Descriptores</td><td colspan="3">Los descriptores se presentarán en Castellano e inglés para su uso en las bases de datos traducidos al lenguaje documental a partir de las palabras clave generadas en DESC
<table>
<tr><td></td><td>Castellano</td><td>Inglés</td></tr>
<tr><td>Raíz</td><td>Ejercicio
Actividad física
Intestino irritable
Estreñimiento
Mujeres
femenino</td><td>Exercise
Physical activity
Irritable bowel
Constipation
Women
Female</td></tr>
<tr><td>Secundario(s)</td><td>Dieta
Nutrición
Efectos gastrointestinales</td><td>Diet
Nutrition
Intestinal effects</td></tr>
<tr><td>Marginale(s)</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Booleanos</td><td colspan="3">Especificar los tres niveles de combinación con booleanos
<table>
<tr><td>1er Nivel</td><td>(((exercise OR physical activity) AND (irritable bowel OR constipation) AND (women OR female)))</td></tr>
<tr><td>2do Nivel</td><td>(((exercise OR physical activity) AND (irritable bowel OR constipation) AND (women OR female) AND (diet OR nutrition)))</td></tr>
<tr><td>3er Nivel</td><td>(((exercise OR physical activity) AND (irritable bowel OR constipation) AND (women OR female) AND (diet OR nutrition) AND (gastrointestinal effects)))</td></tr>
</table></td></tr>
<tr><td></td><td colspan="3">Ej: Si deseo estudiar los cuidados a un paciente con Demencia en tratamiento con Neurolépticos: Ciencias de la Salud, Fisiología, Neurología, Enfermería, farmacología.</td></tr>
</table>

Área de Conocimiento	Ciencias de la salud				
Selección de Bases de Datos	*Metabuscadores* EBSCOhost sí BVS sí OVID □ CSIC □ Otras □	*Bases de Datos Específicas* Pubmed sí Embase □ Medline sí Ibecs □ Psyinfo □ LILACS □ Cuiden □ CINHAL □ Web of Knowledge □ Otras (especificar) □	*Bases de Datos Revisiones* Cochrene sí Excelencia Clínica □ PEDro □ JBI □ Otras (especificar) □		
Años de Publicación	Entre los últimos 5 y 10 años.				
Idiomas	Todos los idiomas				
Otros Límites	1.				
	2.				
	3.				
Resultados de la Búsqueda					
Metabuscador	EBSCOHost				
Combinaciones	1er Nivel	(Exercise or physical activity) AND (irritable bowel or constipation) AND (women or female)			
	2do Nivel	(Exercise or physical activity) AND (irritable bowel or constipation) AND (women or female) AND (diet or nutrition)			
	3er Nivel	(Exercise or physical activity) AND (irritable bowel or constipation) AND (women or female) AND (diet or nutrition) AND (gastrointestinal effects)			
Límites introducidos	Buscar todos mis términos de búsqueda, aplicar palabras seleccionadas, texto completo, 5 años.				
Resultados	1er Nivel	N.º 308	Resultado final		
	2do Nivel	N.º 77	15		
	3er Nivel	N.º 17	Criterios de Exclusión		
	Otros	N.º	Sin interés para mi tema de investigación	340	
			Déficit de calidad del estudio	0	
			Dificultades para la obtención de fuentes primarias	28	
			Repetidos	18	
Base de Datos Específica 1	BVS				
Combinaciones	1er Nivel	(Exercise or physical activity) AND (irritable bowel or constipation) AND (women or female)			
	2do Nivel	(Exercise or physical activity) AND (irritable bowel or constipation) AND (women or female) AND (diet or nutrition)			
	3er Nivel	(Exercise or physical activity) AND (irritable bowel or constipation) AND (women or female) AND (diet or nutrition) AND (gastrointestinal effects)			
Límites introducidos	5 años, texto completo, inglés y español, síndrome colon irritable				
Resultados	1er Nivel	N.º 79	Resultado final		
	2do Nivel	N.º 15	5		

	3er Nivel	N5 5	Criterios de Exclusión	
	Otros	N.º	Sin interés para mi tema de investigación	76
			Déficit de calidad del estudio	0
			Dificultades para la obtención de fuentes primarias	10
			Repetidos	8
Base de Datos Específica 2	PUBMED			
Combinaciones	1er Nivel	(Exercise or physical activity) AND (irritable bowel or constipation) AND (women or female)		
	2do Nivel	(Exercise or physical activity) AND (irritable bowel or constipation) AND (women or female) AND (diet or nutrition)		
	3er Nivel	(Exercise or physical activity) AND (irritable bowel or constipation) AND (women or female) AND (diet or nutrition) AND (gastrointestinal effects)		
Límites introducidos	5 años			
Resultados	1er Nivel	N.º 180	Resultado final	
	2do Nivel	N.º 64	3	
	3er Nivel	N.º 17	Criterios de Exclusión	
	Otros	N.º 261	Sin interés para mi tema de investigación	214
			Déficit de calidad del estudio	0
			Dificultades para la obtención de fuentes primarias	15
			Repetidos	29
Base de Datos Específica 3	MEDLINE			
Combinaciones	1er Nivel	(Exercise or physical activity) AND (irritable bowel or constipation) AND (women or female)		
	2do Nivel	(Exercise or physical activity) AND (irritable bowel or constipation) AND (women or female) AND (diet or nutrition)		
	3er Nivel	(Exercise or physical activity) AND (irritable bowel or constipation) AND (women or female) AND (diet or nutrition) AND (gastrointestinal effects)		
Límites introducidos				
Resultados	1er Nivel	N.º 77	Resultado final	
	2do Nivel	N.º 17	1	
	3er Nivel	N.º 4	Criterios de Exclusión	
	Otros	N.º	Sin interés para mi tema de investigación	83
			Déficit de calidad del estudio	0
			Dificultades para la obtención de fuentes primarias	1
			Repetidos	13
Base de Datos de Revisión 1	Cochrane			
Combinaciones	1er Nivel	(Exercise or physical activity) AND (irritable bowel or constipation) AND (women or female)		
	2do Nivel	(Exercise or physical activity) AND (irritable bowel or constipation) AND (women or female) AND (diet or nutrition)		
	3er Nivel	(Exercise or physical activity) AND (irritable bowel or constipation) AND (women or female) AND (diet or nutrition) AND (gastrointestinal effects)		
Límites introducidos	5 años			
Resultados	1er Nivel	N.º RV: 5 /EC: 282	Resultado final	
	2do Nivel	N.º 78	0	

	3er Nivel	N.º 35	Criterios de Exclusión	
	Otros	N.º	Sin interés para mi tema de investigación	370
			Déficit de calidad del estudio	0
			Dificultades para la obtención de fuentes primarias	10

Obtención de la Fuente Primaria	
Directamente de la base de datos	X
Préstamo Interbibliotecario	
Biblioteca digital de la UIB	X
Biblioteca física de la UIB	
Otros (especificar)	

Anexo 3. Tabla pico

Autor, año	Diseño	Muestra	Inclusión*	Exclusión*	G.Exp	G.Cont	Seguimiento	Variables	Resultados (pre-post)
Hamaguchi T, 2020.	Estudio observacional.	101 estudiantes de los cuales 78 fueron mujeres y 23 hombres.	Estudiantes universitarios >20 años y Estudiantes de edad avanzada y diagnosticados con síntomas de SII según los criterios ROMA III: recurrente dolor o malestar abdominal asociado con dos o más de los siguientes: 1) mejoría con defecación; y/o 2) inicio asociado con un cambio en la frecuencia de las deposiciones; y/o 3) inicio asociado con un cambio en la forma de las	Estudiantes que tomaban medicamentos para el tratamiento del SII 12 semanas antes del inicio del estudio y estudiantes en los que el aparato locomotor no se pudo medir durante 1 semana.			Desde otoño a invierno (de octubre a enero) Los alumnos llevaron consigo podómetros (LifeCorder gs, Suzuken, Tokio). Se les indicó que midieran su actividad durante 1 semana excepto al tomar un baño.	Variables demográficas: Edad, sexo, actividad física y síntomas gastrointestinales. *investiga la relación entre el número de pasos diarios y los síntomas gastrointestinales. Variables instrumentales: Criterio de ROMA III, sirve para diagnosticar los síntomas del SII, que incluyen dolor o malestar abdominal recurrente, 3 días al mes en los últimos 3 meses (12 semanas) y están	De 101 participantes, los subtipos de SII fueron: estreñimiento (n = 42), tipo mixto (n = 29), diarrea (n = 25) El número de alumnas con SII fue mayor que en hombres. Probabilidad de que la actividad locomotora diaria discrimine entre las puntuaciones GSRS 5 y 4 (es decir, probabilidad de tener síntomas graves) se redujo de acuerdo con el incremento de

			heces durante al menos 3 meses en los últimos 6 meses.					relacionados con dos o más de los siguientes criterios: 1) mejoría con la defecación, 2) el inicio está asociado con un cambio en la frecuencia de las deposiciones, y 3) el inicio está asociado con un cambio en la forma de las heces. <u>Escala de valoración de síntomas gastrointestinales (GSRS):</u> Instrumentos de 15 elementos combinados en 5 grupos de síntomas que representan. reflujo, dolor abdominal, indigestión, diarrea y estreñimiento. Grave: 5	pasos por día: 78% de probabilidad para 4000 pasos, 70% de probabilidad para 6000 pasos, 59% de probabilidad para 8000 pasos, y 48% de probabilidad para 10000 pasos. las puntuaciones GSPS de 5 y 4 se redujo con la actividad diaria locomotora con el incremento de pasos al día. En hombres NO hay diferencia significativa en los resultados pero SÍ diferencia significativa en mujeres con el incremento de pasos al día. Las

								Moderado: 4 Molestias menores: 2 <u>Lifeyzer05:</u> aplicación donde se registraron los resultados de los podómetros.	molestias se pueden reducir con: 4000 pasos un 79% 6000 pasos un 71% 8000 pasos un 62% 10000 pasos un 52%. La actividad para discriminar entre las puntuaciones GSRS 5 y 4 fue del 60% de probabilidad para 8500 pasos por día en referencia a los pasos diarios necesarios en mujeres sanas recomendados por Health Japan 21.
Fani M, 2018.	Ensayo clínico.	20 mujeres con SII leve y moderado.	Mujeres con IBS leve y moderado, poder incrementar el nivel de	Realizar ejercicios aeróbicos, tener antecedentes de enfermedades	10 mujeres grupos intervención (cinta rodante).	10 mujeres grupo control.	Grupo intervención realizó ejercicios en cinta	<u>Variables instrumentales:</u> Criterios ROMA III, cuestionario IBS-SSS (mide la	Diferencias significativas entre las puntuaciones de gravedad de

			actividad física, tener entre 18 y 65 años y tener presión arterial estable de referencia.	reumáticas en MMII, tener antecedentes de enfermedades metabólicas, trastornos neurológicos, problemas cardiovasculares y respiratorias, renales y problemas pulmonares que le impedirán participar en ejercicios aeróbicos. Tener antecedentes de lesión de rodilla o cirugía de rodilla durante el último año. Tener antecedentes de reemplazo articular en cualquiera de las articulaciones de MMII. Tener antecedentes de			rodante 3 veces a la semana 25min durante 6 semanas.	gravedad, frecuencia del dolor y distensión abdominal). <u>Escala visual analógica (VAS).</u>	síntomas y calidad de vida antes y después de la intervención en el grupo de cinta rodante (aumento de la calidad de vida y diminución de la gravedad de los síntomas). En el grupo control no hubo diferencia entre las puntuaciones de gravedad de síntomas y calidad de vida antes y después del estudio.

				fractura en la extremidad inferior durante los últimos 6 meses. Tener síntomas clínicos de osteoartritis en las articulaciones de cadera, rodilla, tobillo y pie. Trastornos de la visión. Trastornos musculoesqueléticos hereditarios o adquiridos en MMII. Tener trastornos gastrointestinales orgánicos. Usar drogas que puedan afectar el metabolismo o equilibrio. Usar dispositivos de asistencia para caminar.					

				Embarazo.					
Mehdi Sadeghian, 2018.	Estudio transversal.	4763 iraníes adultos, edad media de 36 años			Grupo actividad física.	Grupo sedentario.		<u>Variables instrumentales</u> Evaluación de la práctica de actividad física de práctica general (GPPAQ): 1) inactivo "trabajo sedentario y sin ejercicio físico", 2) moderadamente inactivo "trabajo sedentario y <1h ejercicio físico/bicicleta", 3) moderadamente activo "trabajo sedentario y 1 a2h ejercicio o bicicleta, 4) activo "trabajo sedentario y >3h ejercicio físico por semana o trabajo de pie. <u>Evaluación SII</u> Criterio ROMA III.	SII fue entre el 21'5% de los participantes. En comparación con los individuos físicamente activos (1h/semana) con aquellos con actividad física sedentaria (<1h/semana) tenían 1'27 veces mayor probabilidad de padecer SII. Cuando la asociación se ajustó a las variables de sexo, edad, comida, etc. la asociación entre actividad física y SII no fueron significativos en hombres, sin

								<u>Evaluación de otras variables:</u> sexo, edad, peso, altura, tabaquismo, educación, historia clínica, medicamentos, comidas, hidratación.	embargo, en mujeres si se encontró asociación con la actividad sedentaria y las probabilidades de padecer SII fueron de un 29% más que las personas físicamente activas. Entre los individuos con peso normal, aquellos con actividad física sedentaria tenían un 35% más probabilidades de SII que los participantes físicamente activos.
Johannesson E, 2018.	Estudio cualitativo.	15 personas (10 mujeres y		Enfermedades orgánicas gastrointestinales				Entrevistas de 30 a 80 min, grabaron y transcribieron.	En relación a los síntomas gastrointestinales, los pacientes

		5 hombres), de 31-78 años.							discutieron cómo la actividad física afectó a estos síntomas y como la utilizaron para normalizar y controlar los síntomas. Los síntomas extra también se vieron afectados por la actividad física, y los pacientes describieron cómo experimentaron un bienestar corporal general, así como una mejora del estado de ánimo y la energía en relación a la actividad física. Los pacientes discutieron sus perspectivas sobre

									la actividad física como un logro, ser placentero y fortalecerse así mismo.
Maleki BH, 2017.	Estudio ensayo controlado aleatorio, estudio longitudinal.	109 mujeres de 18 a 41 años. Tamaño de muestra: 30 51 pacientes incluido en el análisis.	No fumadores, libres de enfermedades sistémicas (gastrointestinales) incluida enfermedad inflamatoria intestinal, no tomar antioxidantes. Cumplían criterios ROMA III.	Problemas cardiovasculares, cirugía abdominal, condiciones comórbidas, trastornos endocrinos, metabólicos o afecciones, personas que participan en una actividad física regular (por un mínimo de 6 meses antes del estudio) o acumulado 25min o más de actividad física de intensidad moderada la mayoría de los días de la semana.	GRUPO EX: ejercicio n=30.	GRUPO NO EX: no ejercicio n=30.	Seguimiento durante 24 semanas de ejercicios aeróbico moderado en pacientes con SII sedentario. 12 semanas sobre la intervención de ejercicios. 60 días sobre medidas dietéticas y de ingesta de medicamentos.	<u>Cuestionario de historia médica</u>: perfil de sangre en ayunas, examen de ejercicio físico <u>Diseño experimental:</u> Criterio ROMA III <u>Intervención de ejercicios:</u> Sistema automatizado respiración por respiración para mirar el consumo máximo de oxígeno (CPX, medical graphics, st.Paul, MN, EE.UU) durante 12 semanas <u>Medidas dietéticas y de ingesta de</u>	<u>Al inicio:</u> la calidad, cantidad y frecuencia de consumo de alimentos fueron similar en ambos grupos. <u>Post:</u> las citoquinas disminuyeron a las 12 y 24 semanas. La actividad enzimática de la EA disminuyó significativamente en las 12 y 24 semanas. Oxidantes y antioxidantes aumento a las 12 y 24 semanas en

				Personas embarazadas, mujeres con inmunodeficiencia reconocida o intolerancia a la lactosa, obesidad excesiva, enfermedad psiquiátrica, alcohol y abuso o dependencia de sustancias. Aquellos que no pueden aumentar su nivel de actividad física.			Semana 12 y 24. 30-60 días se extrajeron muestras de sangre de 20ml en tubos que contenían ácido etilendiaminotetraacético Actividad de oxígeno fue calculado en µmol de ácido úrico producido por minuto a 37 ° C, pH 7,5.	<u>medicamentos:</u> cuestionario semicuantitativo validado de frecuencia alimentaria (FFQ) <u>Análisis bioquímicos</u>: superóxido dismutasa (SOD), catalasa (CAT), glutatión peroxidasa (GSH-Px), xantina oxidasa (XO), adenosina actividades de desaminasa (AD) y malondialdehído (MDA) <u>Ensayo de actividad XO:</u> se evaluó la actividad plasmática de oxígeno a través de la mejora de absorbencia como	relación con la línea base <u>Grupo EX</u> (ejercicio): disminución del peso y grasa corporal, el índice de masa corporal (IMC). El VO2máx aumentó. La ingesta de energía, proteínas y carbohidratos y grasas disminuyó significativamente después de 24 semanas. Niveles de IL-10 se elevaron desde el inicio a las 12 y 24 semanas y volvió a los valores basales 30 días después del ejercicio.

								resultado de ácido úrico.	La actividad enzimática de la EA permaneció significativamente más bajo 60 días después del ejercicio. <u>GRUPO NO-EX</u> (no ejercicio): las citoquinas no mostraron cambios significativos.
Chatila R, 2017.	Estudio observacional.	553 adultos libaneses, 52’7 mujeres y 47’3 hombres de 18 a 65 años, la edad media fue entre hombres y mujeres fue 35’9.						<u>Cuestionario:</u> aspectos socioeconómicos, demográficos y características de comportamiento (sexo, edad, educación y distribución global), patrones de tabaquismo, consumo de alcohol, actividad física e intolerancia alimentaria.	La prevalencia y asociación bivariado del SII por factores de riesgo según el criterio Roma III fue del 20’1. Varia por factores sociodemográficos y de estilo de vida. La prevalencia fue mayor en mujeres (22’9%) en comparación a

								Criterios ROMA III: prevalencia y diagnóstico del SII.	los hombres con un 16’9%. Mayores de 30 años informaron menos SII que los menores de 30 años. Se observó diferencia significativa al nivel educativo de los encuestados. Una mayor proporción de hombres eran físicamente activos (77'9%) en comparación con las mujeres (53’8%).
Shahabi L, 2016.	Estudio piloto.	27 participantes. Mujeres y hombres de 18 a 65 años.	Trastorno psiquiátrico sólo ansiedad y depresión. Tomar medicamentos psicotrópicos si	Trastornos psiquiátricos como esquizofrenia o trastorno bipolar.	Grupo de yoga. Grupo Wolking.	X	6 meses de Seguimiento de asistencia en clases de yoga y Wolking.	Criterio ROMA III Escala numérica de dolor NRS de 21 puntos. (puntuación alta significa mayor gravedad).	El yoga mostró disminuciones significativas en la medida de gravedad del SII, la sensibilidad visceral y la gravedad de los

			se administran durante 3 meses.					Programa de efectos negativos y positivos (PANAS-X) 60 ítems, escala que mide los sentimientos y emociones actuales. <u>Índice de sensibilidad visceral (VSI).</u> Escala validada de 15 ítems que mide la ansiedad específica de los síntomas gastrointestinales (puntuaciones más altas significan mayor ansiedad específica de los síntomas gastrointestinales). <u>Cuestionario de salud del paciente 15 PHQ-15)</u> escala de 15 ítems de gravedad de los	síntomas somáticos. Caminar mostró disminuciones significativas en los síntomas gastrointestinales generales, afecto negativo y estado de ansiedad. Pasados los 6 meses, al caminar los síntomas disminuyeron significativament e mientras que en el yoga los síntomas recuperaron los niveles iniciales al tratamiento. Después del tratamiento había más gente que caminaba en comparación a la práctica de yoga.

								síntomas. (puntaciones más altas significan más síntomas somáticos). <u>Inventario de ansiedad del estado Spielberger (STAI)</u> escala de 20 ítems que pide la ansiedad del estado es una escala de 4 puntos. (las puntuaciones más altas significan mayor ansiedad).	
Elhosseiny D, 2019.	Analítico transversal (observacional).	382 alumnos de medicina de 18 a 25 años.		Trastornos gastrointestinales orgánicos conocidos o individuos con síntomas alarmantes como es la pérdida de peso o heces con sangre.			Seguimiento de 4 meses, desde octubre de 2017 a febrero de 2018.	<u>Cuestionario autoadministrado</u> para recopilar información sociodemográfica, hábitos como el ejercicio físico. <u>Frecuencia de alimentos (FFQ)</u> para evaluación dietética.	Diferencias estadísticamente significativas entre los estudiantes respecto al sexo, estapa académica, antecedentes familiares de SII Diferencia significativa con

								Escala (HADS) versión árabe de ansiedad y depresión hospitalaria. Utilizan escala Likert Criterios ROMA III. Para diagnóstico de trastornos funcionales	respecto al rendimiento del ejercicio regular entre los alumnos IBS Y alumnos normales. Diferencia estadísticamente significativa con respecto a la depresión y a la ansiedad mórbida en los subtipos de SII. Una regresión logística multivariante muestra que el SII está significativament e asociado con antecedentes familiares positivos, siendo una mujer, ocurrencia de eventos traumáticos en la

									infancia y realizar ejercicio regular que demostró ser protector contra el SII.
Yurtdas G, 2020.	Estudio transversal (observacional).	4561 adultos de Turquía. 60’3% mujeres y 39’7% hombres. (entre 18 a 65 años).		Aquellas personas que utilizan productos y medicamentos que afectan a las deposiciones. Mujeres embarazadas, lactantes. Participantes con valores perdidos o valores atípicos para algunas preguntas y los participantes con intenciones en cambios de dieta en el mes anterior.			5 meses. Desde mayo de 2018 a septiembre de 2018	**Alimentación:** <u>Cuestionario frecuencia alimentaria (FFQ):</u> evalúa fibra dietética y la ingesta de líquidos y agua. El FFQ se modificó considerando los alimentos consumidos con más frecuencia en Turquía para adaptar la dieta turca. <u>Medidas antropométricas:</u> bascula electrónica de la marca DR.Mod 85: peso de los participantes.	La prevalencia de estreñimiento fue mayor en mujeres que en hombres. La prevalencia del estreñimiento aumentó con la edad, desde 12’6 en el grupo de edad de 18 a 29 años a 27’7% en el grupo de 60 a 65 años. Mayor prevalencia de estreñimiento en participantes con sobrepeso. La prevalencia del estreñimiento aumentó con la actividad física,

								Estadiómetro portátil: medir altura Índice de masa corporal (IMC) Actividad física: Cuestionario internacional de actividad física-breve (IPAQ-SF): formulario.	del grupo activo 13’9%, moderadamente activo 14’9% e inactivo 20’6%. La prevalencia de estreñimiento fue más alta en los participantes en el cuartil medio inferior de la dieta con ingesta de fibra e ingesta total de líquido entre 1/L. Riesgo mayor de estreñimiento en mujeres participantes, edad avanzada, obesidad mientras que la ingesta de líquidos no se asoció con estreñimiento.

									Los participantes moderadamente activos, participantes activos tuvieron menor probabilidad de estreñimiento en comparación con los participantes inactivos.
Falcón BS, 2017.	Estudio descriptivo.	1000 personas. Muestra aleatoria de la población española mayor de 65 años.	Personas mayores de 65 años capaz de comprender y responder.	No mayores de 65 años.	Estreñimiento e incontinencia fecal.			Datos sociodemográficos: Cuestionario validado: resultado con Kappa Ingesta de fibra y actividad física**:** cuestionarios previamente utilizados en dos estudios. Cuestionario ROMA III	Prevalencia del estreñimiento crónico (CC) 181 personas, incontinencia fecal 56 e impactación fecal 53, de los cuales debido a estreñimiento son 25 personas. Estreñimiento y factores asociados: 181 personas conocieron la Roma III criterios para CC, que representa una

									prevalencia del 18,1%, 166 personas reconocieron el uso regular de laxantes durante el último año, De ellos, 143 personas usaron solo un laxante. Factores asociados: sexo femenino, exfumadores. IF y factores asociados: 38 hacia uso de enemas y 15 necesitaban de técnica manual para la extracción. Factores asociados: Rango de edad 71 a 80 años, género femenino, estado civil viudo, exfumador, bajo consumo de fibra, actividad física

									moderada, comorbilidades como la enfermedad de Parkinson, insuficiencia cardíaca, insuficiencia renal y depresión, y consumo de Los AINE.
Moezi P, 2018.	Estudio transversal (observacional).	9.264 sujetos con edades comprendidas entre los 40 y 75 años.				Estreñimiento crónico.	NO estreñimiento crónico.	<u>Variables demográficas:</u> Edad, sexo, IMC, presión arterial sistólica y diastólica, nivel educativo, situación socioeconómica, estado civil, etnia, actividad física, tabaquismo, opio y alcohol consumo y enfermedades médicas auto informadas (corazón enfermedad que incluye	752 participantes fueron diagnosticados con estreñimiento crónico (CC). La prevalencia de CC fue del 9,3% para las mujeres y 6,7% para hombres. Prevalencia de CC entre los participantes que tenían 60 años y más se estimó en 11’9%

								insuficiencia cardíaca, angina y miocardio infarto), ictus, hipertensión, diabetes mellitus, enfermedad hepática, enfermedad renal crónica, enfermedad obstructiva crónica enfermedad pulmonar, ansiedad, depresión, dolor de espalda o artralgia, insomnio, antecedentes de cirugía previa, antecedentes de cáncer previo y enfermedad por reflujo gastroesofágico (ERGE) fueron considerados como factores asociados de la prevalencia del CC.	El participante con menor actividad física tuvo una mayor prevalencia de CC en comparación con los que fueron físicamente más activo 9’1%. Prevalencia de CC fue del 9’1 en participantes con nivel económico y 6’5% para aquellos que estaban en un nivel superior. No hubo relación significativa entre el IMC y el CC. Tabaquismo, opio y alcohol fueron significativament e asociado con CC en hombres.

								IMC se clasificó según la OMS en subgrupos: peso inferior al normal 18’5, normal18-25, sobrepeso 25 y obeso a partir de 30. Nivel educativo: analfabetos, menos de 5 años, 6-12 años y universitarios. Cuestionario internacional de actividad física (IPAQ), las puntuaciones (MET) se clasificaron en: actividad física baja, media y alta. Tabaco: consumo de opio: 1 vez a la semana en los último 6 meses.	Prevalencia de CC fue significativamente mayor en pacientes con enfermedad cardíaca, accidente cerebrovascular, diabetes mellitus, ansiedad, depresión, dolor de espalda, insomnio, antecedentes de cirugía previa.

								Alcohol: consumir una vez al mes durante los últimos 6 meses.	
Iftikhar B, 2018.	Estudio transversal (observacional).	552 estudiantes de 18-25 años.					6 meses (de enero a junio de 2017).	Criterios de ROMA III para determinar el SII. DASS 21: evalúa estrés moderado y severo, depresión y ansiedad. Índice de calidad de sueño de Pittsburgh (PSQI): determina calidad de sueño.	Entre 552 estudiantes de medicina, 74 tuvieron SII, prevalencia en hombres 13’4% y en mujeres 17’5%. Asociación de SII con estrés (severo/alto, moderado y media/baja. De 551 estudiantes de los cuales 156 (28’3%) tenían estrés severo alto de los cuales el 21’8 era positivo en IBS. De 336 estudiantes (60’9%) tenían

									grado moderado de estrés de los cuales el 10’7% era positivo en SII. De 60 estudiantes el 10’9% sufrieron bajo nivel de estrés de los cuales el 6’7% era positivo en SII. <u>Calidad de sueño</u>: De 360 estudiantes el 65’2% tenían buena calidad de sueño de los cuales el 10% era positivo en SII. Entre 118 estudiantes 21’4% tenía buen grado de sueño del cual el 20’3% era positivo en SII.

									Entre 71 estudiantes el 13’% tenía mala calidad de sueño del cual el 16’2% era positivo en SII.
Gao R, 2019.	Revisión sistemática y metaanálisis de ensayos controlados aleatorios.	Un total de 680 participantes de 9 estudios de los cuales 8 involucraron ejercicio aeróbico y 1 estudio involucró ejercicio anaeróbico.	Estudios aleatorios con ensayos controlados publicados como un manuscrito completo. Los participantes del estudio eran adultos (18 años), diagnosticados con estreñimiento no inducido por fármacos u otras enfermedades.	Pacientes con enfermedad mental en estos o trastornos cognitivos y Mujeres embarazadas o han dado a luz recientemente.	351 pacientes.	339 pacientes.	6 meses.		<u>Efectos del ejercicio aeróbico y anaeróbico en estreñimiento:</u> 351 pacientes grupo intervención y 339 en el grupo control. En comparación con la atención habitual, estilo de vida normal, educación, pastillas y acupuntura auricular, el efecto general del ejercicio sobre el estreñimiento fue

			Los pacientes pudieron hacer ejercicio sin ayuda. El equipo y el tipo de intervenciones con ejercicios se describieron en detalle.						significativo. Los resultados de los estudios incluidos mostraron que el ejercicio aeróbico había mejora de los síntomas del estreñimiento, aunque hubo heterogeneidad. SÓLO un estudio involucró ejercicio anaeróbico y mostró que la resistencia 2 veces a la semana. Los programas de ejercicio de entrenamiento duraron 6 meses y no afectaron la actividad física habitual ni el estreñimiento en los habitantes. <u>Ejercicio aeróbico:</u> 2

									estudios realizaron intervenciones de 180-300min/semana. 5 estudios la intervención era caminar 60-210 min. 1 estudio de intervención de movimiento duro duró 280-420min se hacían 2 veces a la semana con una duración de 80 a 120min por semana. <u>Efectos de diferentes tipos de ejercicio aeróbico en estreñimiento</u> 2 estudios mostraron que 12 semanas de QiGong mejoraron significativamente los síntomas de

									estreñimiento en el grupo de intervención en comparación con el grupo control que recibe la atención habitual. Después de las 12 semanas, las cinco dimensiones de calidad de vida (dolor corporal, salud general, vitalidad, rol emocional y salud mental) mejoraron significativamente en el grupo de intervención en comparación con el grupo de comparación que recibió la atención habitual. <u>Efectos del caminar sobre el estreñimiento</u>**:** 5

									estudios evaluaron la intervención de ejercicio que varió de 4 a 12 semanas. los síntomas de estreñimiento mejoraron. Wu y col encontraron que la eficacia de la caminata diaria de 20 a 30 min fue mejor que la acupuntura, después de 30 días de intervención y 12 meses de seguimiento. Yo y col encontraron mejora de las características de las heces y la hinchazón en la intervención fue mejor que el grupo control.

									TANTAWY y col encontraron que las comparaciones intergrupales mostraron que las pacientes de grupo intervención mostraron mayores mejoras en la calidad de vida, tanto en términos de las aspectos físicos y emocionales. De Schryver y col. Después de un periodo de 12 semanas de intervención encontraron que los tiempos de tránsito acelerados eran evidentes en el grupo intervención <u>Efectos del movimiento físico</u>

									<u>sobre el estreñimiento:</u> Jing y col encontraron que después de un periodo de intervención de 8 semanas, comparado con el grupo de control, los síntomas de estreñimiento, el bienestar general, el efecto positivo y el afecto negativos, la experiencia positiva y la experiencia negativa mejoraron significativamente para las personas mayores en enfermería.
Huang R, 2017.	Diseño transversal (observacional).	1568 mujeres de 8			Mujeres con CC.	Mujeres sin CC.	De abril a octubre de 2015.	<u>Variables de estudio</u>**:** Cuestionario estructurado, que	De 1568 mujeres 77 fueron diagnosticadas de CC según los

		comunidades.						incluía características demográficas, hábitos de estilo de vida, información médica y situación de defecación. Sangre en ayunas glucosas (FBG) y mediciones antropométricas, que incluyen peso actual, altura y circunferencias de la cintura y caderas, también se tomaron utilizando un protocolo estándar. Encuesta propia: Información general: edad, el índice de masa corporal (IMC), la relación cintura-cadera (WHR), FBG, estado civil, nivel educativo, ocupación actual /	criterios ROMA III. La CC aumentó con la edad con un 4’5% en el grupo de 50 a 59 y Un 6’0% en el grupo de 80%. las Mujeres con CC tenían más posibilidades de tener sobrepeso/obesidad, realizar trabajos no manuales y comer dietas a base de carne, pero es menos probable que realicen ejercicio físico además de estar en el periodo premenopáusico, no tener un historial de parto y sufrir una mala calidad de sueño.

								pasada, situación menstrual e historial de partos. <u>Hábitos de estilo de vida:</u> tabaquismo y consumo de alcohol, calidad del sueño autoevaluada, estructura de la dieta, frecuencias de consumo de frutas y ejercicio físico. <u>Criterio ROMA III</u>	<u>Factores de riesgo asociados a CC:</u> Hubo asociación de CC con cada variable como son: IMC 25kg/$m^{2,}$ ocupación no Manuel, periodo premenopáusico, mala calidad del sueño, historial de parto, dieta base de carne y menos ejercicio físico en población de mujeres en edad de 50 años o más. No se detectó una asociación por la edad, nivel educativo o la diabetes.
Yilmaz S, 2020.	Estudio transversal (observacional).	426 sujetos entre 14 y 65 años. 230 hombres y		Aquellos que no completaron el cuestionario.			Marzo de 2019 y mayo de 2019.	<u>Cuestionario:</u> Caracteres demográficos como edad, sexo, ocupación y matrimonio estado,	De 426 sujetos la prevalencia de SII fue de 130 personas.

		196 mujeres.						IMC, tabaquismo, antecedentes familiares de SII, sueño, privación, comida rápida, comida picante, consumo de café y té, y ejercicio físico. <u>Criterios ROMA III:</u> para el diagnóstico de IBS <u>Escala (HADS):</u> ansiedad y depresión. <u>Formulario de Google:</u> para distribuir el cuestionario en línea	El género, la depresión, la ansiedad y participantes físicamente inactivos mostraron estadísticas significativamente asociadas con IBS sintomático. Fumar, antecedentes familiares de SII, sueño inadecuado, frecuente consumo de comida rápida, comida picante, café, y té. IMC (> 25 kg / m2) y la edad no se mostró significación estadística con IBS.
Mendoza APM, 2020.	Diseño de casos y controles.	70 mujeres con	<u>Para grupo control:</u> Mujeres con edades	<u>Para grupo control:</u> Embarazo,	34 mujeres con SII.	36 mujeres sanas.		<u>Anamnesis:</u> información sobre antecedentes	Hubo diferencia significativa en la circunferencia de

		edades entre 20-29 años.	comprendidas entre 18 y 59 años estable durante los últimos seis meses, IMC <30jg/m^2, sin cambios en la dieta durante los últimos 6 meses. <u>Para grupo casos:</u> mujeres con edad entre 18-19 años, diagnóstico confirmado de SII según ROME III, y no estar bajo seguimiento nutricional.	pacientes con otras enfermedades que afectan el estado nutricional y la ingesta dietética (diabetes, dislipidemias, cáncer, SIDA, enfermedades del tracto gastrointestinal como como malformación intestinal, síndrome del intestino corto, intestino irritable síndrome, enfermedad celíaca, intolerancia a la lactosa, inflamación intestinal enfermedad y enfermedad de Crohn) y				médicos personales y antecedentes familiares relacionados con enfermedades gastrointestinales. <u>Hábitos de vida</u>**:** El nivel de actividad física fue evaluado por el International <u>Cuestionario de actividad física (IPAQ)</u> <u>Cuestionario de tabaquismo y bebida alcohólica.</u> El sueño se evaluó en base en la <u>escala de somnolencia de Epworth,</u> traducida y validada a la Versión portugués. presencia de síntomas gastrointestinales en 42 alimentos	la cintura y la cadera evidenciando el riesgo enfermedades metabólicas en el grupo de casos en comparación con el de controles. <u>IMC:</u> se observó sobrepeso en el grupo de casos mientras que en el gripo de control observamos la eutrofia. <u>Uso de medicamentos:</u> grupo de casos mayor frecuencia de comorbilidades asociado con IBS en comparación con el grupo control. NO asociación significativa entre

				trastornos neurológicos que afectan cognición y capacidad para responder a las preguntas. <u>Para grupo casos:</u> embarazo, enfermedades que afectan al estado nutricional e ingesta dietética y estado neurológico.				considerados problemáticos para los portadores del SII. <u>Evaluación de la calidad de vida:</u> cuestionario de calidad de vida del síndrome del intestino irritable" (IBS-QOL). <u>Evaluación antropométrica:</u> escala de ponderación (Welmy® W200) de 200 kg de capacidad máxima. La altura fue medida por un estadiómetro de pared. El IMC se calculó y clasificó según los criterios de la Organización Mundial de la Salud.	el tabaquismo, somnolencia diurna y actividad física con IBS. De 42 alimentos considerados problemáticos que causan agravamientos intestinales 33 alimentos presentaron empeoramiento para los pacientes con SII en comparación con los controles. <u>Calidad de vida:</u> Fue peor en el grupo de casos que en el control. Hubo peor calidad de vida para los dominios disforia, interferencia con la actividad, la imagen corporal,

								Circunferencia: una cinta métrica no extensible, y la lectura se realizó al final de la espiración.	los problemas de salud, la prevención de alimentos, la reacción social, la sexualidad, las relaciones y en la calidad de vida general para los portadores de IBS, en comparación con el grupo de control.

Anexo 4. Fichas de revisión bibliográfica y artículos

FICHA REVISIÓN BIBLIOGRÁFICA

N.º Ficha (por orden)	Código de Referencia interna
1	1E

Cita Bibliográfica (Según Vancouver)	1. Hamaguchi T, Tayama J, Suzuki M, Nakaya N, Takizawa H, Koizumi K, et al. Erratum: The effects of locomotor activity on gastrointestinal symptoms of irritable bowel syndrome among younger people: An observational study (PLoS ONE (2020) 15:5 (e0234089) DOI: 10.1371/journal.pone.0234089). PLoS One. 2020;15(12 December):1-12.	
Introducción	***Justificación del artículo***	El SII se asocia con una reducción de la calidad de vida que puede afectar a las actividades de la vida diaria.
	Objetivo del estudio	Investigar la relación entre la actividad física y el IG síntomas entre las personas más jóvenes con SII y para estimar la extensión de los síntomas gastrointestinales atenuados al logar la cantidad recomendada de actividad diaria según Health Japan 21.
Metodología	***Tipo de estudio***	Estudio observacional
	Año de realización	2020
	Técnica recogida de datos	Encuesta/cuestionario de elaboración propia: Encuesta entre octubre y enero publicada en el tablón de anuncios de la universidad Escala (Validada): Criterio de Roma III, Escala de valoración de síntomas gastrointestinales (GSRS) y escala Likert. Otras: Solicitud de contratación de colaboradores en la encuesta. Médico entrevista a los estudiantes que leyeron el formulario para confirmar presencia o ausencia de síntomas de SII.
	Población y muestra	101 estudiantes universitarios de los cuales 78 fueron mujeres y 23 hombres.
Resultados relevantes	De 101 participantes, los subtipos de SII fueron: estreñimiento (n = 42), tipo mixto (n = 29), diarrea (n = 25). El número de alumnas con SII fue mayor que en hombres. Probabilidad de que la actividad locomotora diaria discrimine entre las puntuaciones GSRS 5 y 4 (es decir, probabilidad de tener síntomas graves) se redujo de acuerdo con el incremento de pasos por día: 78% de probabilidad para 4000 pasos, 70% de probabilidad para 6000 pasos, 59% de probabilidad para 8000 pasos, y 48% de probabilidad para 10000 pasos. las puntuaciones GSPS se redujo con la actividad diaria locomotora con el incremento de pasos al día. En hombres NO hubo diferencia significativa en los resultados pero	

	SÍ hubo diferencia significativa en mujeres con el incremento de pasos al día. Las molestias se pueden reducir con: 4000 pasos un 79% 6000 pasos un 71% 8000 pasos un 62% 10000 pasos un 52%. La actividad para discriminar entre las puntuaciones GSRS 5 y 4 fue del 60% de probabilidad para 8500 pasos por día en referencia a los pasos diarios necesarios en mujeres sanas recomendados por Health Japan 21.
Discusión planteada	La actividad física que utilizaba una guía basada en podómetros podría aumentar los resultados de salud pública con 3000 pasos en 30min (100 pasos/min) considerados como actividad de intensidad moderada. El aumento de actividad física leve mejora la eliminación de gases intestinales y reduce los síntomas en los pacientes con hinchazón. Para aumentar el tiempo de tránsito intestinal del colon en adultos con estreñimiento crónico se recomiendan 30min de caminata diaria para mejorar el patrón de defecación. Un reciente estudio demostró que los biomarcadores inflamatorios se atenuaron después de 24 semanas de ejercicios aeróbico de intensidad moderada. Por lo tanto, la actividad física de rutina puede ser una modalidad de tratamiento primaria útil en el SII. La cantidad recomendada de actividad locomotora DIFIERE entre los jóvenes y los ancianos en HEALTH Japan 21. Según nuestros hallazgos, aumentar el recuento de pasos diarios a 9500 pasos desde 4000 pasos puede resultar una reducción del 50% en la gravedad de los síntomas.
Conclusiones del estudio	cantidad de actividad motora estaba relacionada con los síntomas gastrointestinales en personas más jóvenes con SII. Los resultados sugieren que la cantidad de actividad motora diaria puede atenuar los síntomas del SII entre los más jóvenes, especialmente mujeres.

N.º Ficha (por orden)	Código de Referencia interna
2	2E

Cita Bibliográfica (Según Vancouver)	1. Fani M, Mostamand J, Fani M, Chitsaz N, Feizi A. The effect of aerobic exercises among women with mild and moderate irritable bowel syndrome: A pilot study. J Bodyw Mov Ther. 2019;23(1):161-5.	
Introducción	***Justificación del artículo***	Ningún estudio anterior ha evaluado el efecto de ejercicios aeróbicos sobre la gravedad de los síntomas y la calidad de vida en pacientes con SII.
	Objetivo del estudio	Evaluar el efecto de los ejercicios aeróbicos con cinta rodante sobre la gravedad de los síntomas y calidad de vida entre mujeres con SII leve y moderado.
Metodología	***Tipo de estudio***	Ensayo clínico
	Año de realización	2018
	Técnica recogida de datos	Encuesta/Cuestionario validado: IBS-SSS (miden la gravedad, frecuencia del dolor y distensión abdominal) Escala (Validada): Criterio ROMA III
	Población y muestra	20 mujeres con SII.
Resultados relevantes	Hubo diferencias significativas entre las puntuaciones de gravedad de síntomas y calidad de vida antes y después de la intervención en el grupo de cinta rodante (aumento de la calidad de vida y diminución de la gravedad de los síntomas). En el grupo control no hubo diferencia entre las puntuaciones de gravedad de síntomas y calidad de vida antes y después del estudio.	
Discusión planteada	El primer estudio evaluó el efecto de los ejercicios aeróbicos con cinta rodante. 6 semanas de ejercicio aeróbico con cinta puede aumentar la calidad de vida y disminuir la gravedad de síntomas en mujeres con SII leve y moderado, en comparación con antes de la intervención. No se observaron diferencias significativas entre las puntuaciones de calidad de vida y la gravedad de los síntomas del grupo de control antes y después del estudio. EL programa prescrito tuvo un efecto deseable sobre la gravedad de la síntomas y calidad de vida en pacientes con SII. los resultados del presente estudio fueron consistentes con los resultados de otros autores que mostraron que la actividad física moderada disminuye el tiempo de tránsito del gas y reduce la distensión abdominal en sujetos sanos. También la interacción cerebro-intestino, como factor psicológico, puede ser eficaz en los resultados del presente estudio; significa que, El estrés induce la exageración de la respuesta neuroendocrina y perceptual visceral, mientras que la actividad física contrarresta los efectos del estrés.	
Conclusiones del estudio	6 semanas de Wolking en cinta rodante pueden Disminuir la gravedad de los síntomas y mejorar la calidad de vida. entre mujeres con IBS leve y moderado; A largo plazo, los efectos, de interrumpir el ejercicio siguen sin estar claros.	

N.º Ficha (por orden)	Código de Referencia interna
3	3E

<table>
<tr><td>Cita Bibliográfica (Según Vancouver)</td><td colspan="3">1. Sadeghian M, Sadeghi O, Keshteli AH, Daghaghzadeh H, Esmaillzadeh A, Adibi P. Physical activity in relation to irritable bowel syndrome among Iranian adults. PLoS One. 2018;13(10):1-11.</td></tr>
<tr><td rowspan="2">Introducción</td><td>Justificación del artículo</td><td colspan="2">Se dispone de datos limitados con resultados contradictorios que relacionan la actividad física con el SII. Algunos investigadores no han podido encontrar una asociación significativa entre la actividad física y SII.</td></tr>
<tr><td>Objetivo del estudio</td><td colspan="2">Investigar la asociación de la actividad física con el SII en el marco de un estudio poblacional en Irán (oriente medio).</td></tr>
<tr><td rowspan="4">Metodología</td><td>Tipo de estudio</td><td colspan="2">Estudio transversal (observacional)</td></tr>
<tr><td>Año de realización</td><td colspan="2">2018</td></tr>
<tr><td>Técnica recogida de datos</td><td>Encuesta/Cuestionario validado</td><td>Evaluación de la práctica de actividad física de práctica general (GPPAQ).</td></tr>
<tr><td></td><td>Otros</td><td>Sexo, edad, peso, altura, tabaquismo, educación, historia clínica, medicamentos, comidas, hidratación</td></tr>
<tr><td></td><td></td><td>Escala (Validada)</td><td>Criterio ROMA III</td></tr>
<tr><td></td><td>Población y muestra</td><td colspan="2">4763 iraníes adultos, edad media de 36 años</td></tr>
<tr><td>Resultados relevantes</td><td colspan="3">SII fue entre el 21’5% de los participantes.
En comparación con los individuos físicamente activos (1h/semana) con aquellos con actividad física sedentaria (<1h/semana) tenían 1’27 veces mayor probabilidad de padecer SII. Cuando la asociación se ajustó a las variables de sexo, edad, comida, etc. la asociación entre actividad física y SII no fueron significativos en hombres, sin embargo, en mujeres si se encontró asociación con la actividad sedentaria y las probabilidades de padecer SII fueron de un 29% más que las personas físicamente activas. Entre los individuos con peso normal, aquellos con actividad física sedentaria tenían un 35% más probabilidades de SII que los participantes físicamente activos.</td></tr>
<tr><td>Discusión planteada</td><td colspan="3">El estudio actual fue el primero en examinar la asociación entre la actividad física y el SII en Oriente Medio. Según nuestros hallazgos, las personas con actividad sedentaria tienen mayor riesgo de SII. En conjunto, parece que promover la actividad física en la población en general puede ayudar a prevenir el desarrollo de IBS. Sin embargo, esto no fue significativo después de controlar para las prácticas relacionadas con la dieta y el IMC. Parece que la asociación positiva entre la actividad física sedentaria y el SII está mediada por Hábitos dietéticos o prácticas relacionadas con la dieta.</td></tr>
</table>

	El estrés psicológico es un factor de riesgo para el SII. Se desconocen los mecanismos detrás de la asociación entre la actividad física y el SII. Eso puede explicarse por el cambio de tránsito de gas y tránsito colónico debido a un aumento físico actividad. Además, la actividad física puede influir favorablemente en la plasticidad cerebral al facilitar procesos neurodegenerativos, neuro adaptativos y neuro protectores, por lo que tienen un efecto positivo en los ejes cerebro-intestino que está involucrado en IBS.
Conclusiones del estudio	Encontraron asociación positiva marginalmente significativa entre sedentarismo la actividad física y el síndrome del intestino irritable, especialmente en mujeres e individuos de peso normal. Se necesitan más estudios, particularmente de diseño prospectivo, para confirmar nuestros hallazgos.

N.º Ficha (por orden)	Código de Referencia interna
4	4E

Cita Bibliográfica (Según Vancouver)	1. Johannesson E, Jakobsson Ung E, Sadik R, Ringström G. Experiences of the effects of physical activity in persons with irritable bowel syndrome (IBS): a qualitative content analysis. Scand J Gastroenterol. 2018;53(10-11):1194-200.	
Introducción	***Justificación del artículo***	No se sabe cómo experimentan los pacientes los efectos de actividad física sobre los síntomas del SII
	Objetivo del estudio	Explorar experiencias de los pacientes sobre los efectos de la actividad física.
Metodología	***Tipo de estudio***	Estudio cualitativo.
	Año de realización	2018
	Técnica recogida de datos	Otros: Entrevista propia
	Población y muestra	15 personas (10 mujeres y 5 hombres), de 31-78 años
Resultados relevantes	Los pacientes utilizaron la actividad física para normalizar y controlar los síntomas sus perspectivas sobre la actividad física fueron como un logro, placentero y fortalecerse así mismo. Los síntomas extra también se vieron afectados por la actividad física, y los pacientes describieron cómo experimentaron un bienestar corporal general, así como una mejora del estado de ánimo y la energía en relación con la actividad física	
Discusión planteada	Este estudio cualitativo proporciona una nueva perspectiva y profundiza la compresión de los resultados de los estudios cuantitativos sobre el SII y la actividad física. los pacientes describieron un bienestar general, tanto física como psicológica, en relación con la actividad física.	
Conclusiones del estudio	Enfatizan la importancia de tener en cuenta las experiencias del paciente sobre los efectos de la actividad física al entrenar a los pacientes con SII para que sean físicamente activos. Usando un enfoque centrado en la persona, sus propias experiencias y recursos para promover con éxito la actividad física.	

N.º Ficha (por orden)	Código de Referencia interna
5	5E

Cita Bibliográfica (Según Vancouver)	1. Maleki BH, Tartibian B, Mooren FC, Fitzgerald LZ, Krüger K, Chehrazi M, et al. Low-to-moderate intensity aerobic exercise training modulates irritable bowel syndrome through antioxidative and inflammatory mechanisms in women: Results of a randomized controlled trial. 2017;		
Introducción	***Justificación del artículo***	La etiología del SII no está clara y se ha propuesto múltiples mecanismos para explicar la patogenia de la enfermedad del SII.	
	Objetivo del estudio	Examinar los efectos de 24 semanas de entrenamiento aeróbico moderado sobre citocinas pro y antiinflamatorias, biomarcadores pro-oxidativos como así la gravedad de los síntomas en pacientes sedentarios con SII	
Metodología	***Tipo de estudio***	Ensayo clínico (ensayo controlado aleatorio)	
	Año de realización	2017	
	Técnica recogida de datos	Otros	Cuestionario de historia médica/ cuestionario de frecuencia alimentaria/ análisis bioquímicos/ensayo actividad XO.
		Escala (Validada)	Criterio ROMA III
	Población y muestra	109 mujeres de 18 a 41 años	
Resultados relevantes	Grupo EX (ejercicio): disminución del peso y grasa corporal, el índice de masa corporal (IMC). El VO2máx aumentó. La ingesta de energía, proteínas y carbohidratos y grasas disminuyo significativamente después de 24 semanas. Niveles de IL-10 se elevaron desde el inicio a las 12 y 24 semanas y volvió a los valores basales 30 días después del ejercicio. La actividad enzimática de la EA permaneció significativamente más bajo 60 días después del ejercicio		
Discusión planteada	Los resultados del estudio muestran que el ejercicio aeróbico proporciona beneficios en los síntomas en pacientes con SII. Se mejoraron las concentraciones plasmáticas de parámetros antiinflamatorios y antioxidantes. Este estudio demostró que el entrenamiento con ejercicios aeróbicos disminuye las citocinas proinflamatorias tanto a las 12 como a las 24 semanas posteriores al ejercicio. es posible que un régimen regular de se requiere ejercicio para conservar los beneficios del entrenamiento físico.		
Conclusiones del estudio	El entrenamiento con ejercicios aeróbicos fue eficaz para mejorar biomarcadores antiinflamatorios y antioxidantes, además de suprimir producción de citocinas proinflamatorias y oxidantes en pacientes con SII previamente sedentario.		

<table>
<tr><th colspan="3">N.º Ficha (por orden)</th><th>Código de Referencia interna</th></tr>
<tr><td colspan="3">6</td><td>6E</td></tr>
<tr><td>Cita Bibliográfica (Según Vancouver)</td><td colspan="3">1. Chatila R, Merhi M, Hariri E, Sabbah N, Deeb ME. Irritable bowel syndrome: Prevalence, risk factors in an adult Lebanese population. BMC Gastroenterol. 2017;17(1):1-7.</td></tr>
<tr><td rowspan="5">Introducción</td><td>Justificación del artículo</td><td colspan="2">Faltan estudios epidemiológicos que evalúan la prevalencia del SII específicamente en África y oriente medio, particularmente el Líbano.</td></tr>
<tr><td>Objetivo del estudio</td><td colspan="2">Estimar la prevalencia del SII en un Población libanesa y evaluar los factores de riesgo conductuales, incluidos el tabaquismo, la pipa de agua, el consumo de alcohol y la actividad física asociados con la enfermedad.</td></tr>
<tr><td rowspan="3">Metodología</td><td>Tipo de estudio</td><td colspan="2">Estudio observacional</td></tr>
<tr><td>Año de realización</td><td colspan="2">2017</td></tr>
<tr><td>Técnica recogida de datos</td><td>Encuesta/Cuestionario validado</td><td>Cuestionario: aspectos socioeconómicos, demográficos y características de comportamiento (sexo, edad, educación y distribución global), patrones de tabaquismo, consumo de alcohol, actividad física e intolerancia alimentaria</td></tr>
<tr><td></td><td>Escala (Validada)</td><td>Criterio ROMA III</td></tr>
<tr><td></td><td>Población y muestra</td><td colspan="2">553 adultos libaneses, 52’7 mujeres y 47’3 hombres de 18 a 65 años, la edad media fue entre hombres y mujeres fue 35’9</td></tr>
<tr><td>Resultados relevantes</td><td colspan="3">La prevalencia del SII por factores de riesgo según el criterio Roma III fue del 20’1. Varia por factores sociodemográficos y de estilo de vida. La prevalencia fue mayor en mujeres 22’9% en comparación a los hombres con un 16’9%</td></tr>
<tr><td>Discusión planteada</td><td colspan="3">Hubo una mínima variabilidad en el nivel educativo de los participantes en el estudio en comparación con otros autores, pero es debido a que la población escogida fue de bancarios (gente con buen estatus socioeconómico).
Aquellas personas fumadoras con pipa de agua tenían más SII en comparación con los no fumadores.
Este estudio no mostró que la actividad física estaba asociada significativamente con la aparición de SII en esta muestra adulta de la población libanesa.</td></tr>
<tr><td>Conclusiones del estudio</td><td colspan="3">La prevalencia de SII en nuestra muestra de adultos empleados en los negocios bancarios fue alta, alcanzando el límite superior de prevalencia mundial (20%). Se necesitan factores de riesgo entre los libaneses. Este es uno de los primeros estudios para estimar la prevalencia del SII y su asociación con factores de riesgo del estilo de vida (actividad física, fumar en pipa de agua y el consumo de alcohol) en un subconjunto adulto de la población libanesa.</td></tr>
</table>

N.º Ficha (por orden)	Código de Referencia interna
7	7E

Cita Bibliográfica (Según Vancouver)	1. Shahabi L, Naliboff B, Shapiro D. Self-regulation evaluation of therapeutic yoga and walking for patients wit...: EBSCOhost. Psychol Heal Med. 2016;21(2):176-88.		
Introducción	***Justificación del artículo***	El número de estudios es pequeño y ninguno ha utilizado una condición de comparación contra la cual probar la eficacia del tratamiento. Ningún estudio ha comparado el yoga Iyengar con caminar sin esfuerzo en el SII pacientes.	
	Objetivo del estudio	Evaluar el impacto diferencial del yoga frente a caminar sobre los síntomas y el estado de ánimo del SII y evaluar la influencia de la práctica posterior al tratamiento en los resultados a más largo plazo	
Metodología	***Tipo de estudio***	Estudio piloto descriptivo	
	Año de realización	2016	
	Técnica recogida de datos	Encuesta/Cuestionario validado	Cuestionario de salud del paciente 15 PHQ-15) escala de 15 ítems de gravedad de los síntomas. (puntaciones más altas significan más síntomas somáticos).
		Escala (Validada)	Criterio ROMA III Escala numérica de dolor NRS de 21 puntos. (puntuación alta significa mayor gravedad) Programa de efectos negativos y positivos (PANAS-X) 60 ítems, escala que mide los sentimientos y emociones actuales. Índice de sensibilidad visceral (VSI). Escala validada de 15 ítems que mide la ansiedad específica de los síntomas gastrointestinales (puntuaciones más altas significan mayor ansiedad específica de los síntomas gastrointestinales). Inventario de ansiedad del estado Spielberger (STAI) escala de 20 ítems que pide la ansiedad del estado es una escala de 4 puntos. (las puntuaciones más altas significan mayor ansiedad)

	Población y muestra	27 participantes. Mujeres y hombres de 18 a 65 años
Resultados relevantes	Los resultados sugieren que el yoga y la caminata como tratamientos conductuales autorreguladores basados en el movimiento tienen algunas diferencias, pero ambos son beneficiosos para los pacientes con SII, aunque el mantenimiento de un programa de caminata autorregulado puede ser más factible y, por lo tanto, más efectivo a largo plazo.	
Discusión planteada	Se encontró apoyo para una mayor mejora en el afecto negativo de un programa de caminata de 16 semanas en comparación con el yoga terapéutico. Sin embargo, los resultados no mostraron una condición de tratamiento por interacción de tiempo sobre los síntomas del SII. Estos hallazgos difieren un poco de los estudios anteriores con la combinación de estos dos tratamientos ya que ninguno de los estudios anteriores examinó las diferencias en los pacientes con SII.	
Conclusiones del estudio	El yoga tiene un impacto más significativo en síntomas específicos y caminar tienen un impacto más significativo en el estado de ánimo. Probablemente debido para un porcentaje mayor de participantes que mantenían la práctica habitual en el hogar.	

N.º Ficha (por orden)	Código de Referencia interna
8	8E

Cita Bibliográfica (Según Vancouver)	1. Elhosseiny D, Mahmoud NE, Manzour AF. Factors associated with irritable bowel syndrome among medical students in Ain Shams University. J Egypt Public Health Assoc. 1 de diciembre de 2019;94(1).		
Introducción	***Justificación del artículo***	Falta de estudios sobre la epidemiología del SII entre estudiantes de medicina egipcios.	
	Objetivo del estudio	1. Medir la frecuencia de IBS y sus subtipos. en una muestra de estudiantes de medicina basada en Roma III Criterios. 2. Identificar factores asociados relacionados con el SII (sociodemográficos, algunos hábitos de estilo de vida, y dieta) 3. Investigar la relación entre SII y alteración emocional en relación con la ansiedad mórbida y depresión entre el grupo de estudio.	
Metodología	***Tipo de estudio***	Estudio transversal (observacional)	
	Año de realización	2019	
	Técnica recogida de datos	Encuesta/Cuestionario validado	Cuestionario autoadministrado para recopilar información sociodemográfica, hábitos como el ejercicio físico. Frecuencia de alimentos (FFQ) para evaluación dietética.
		Escala (Validada)	Escala (HADS) versión árabe de ansiedad y depresión hospitalaria. - Utilizan escala Likert Criterios ROMA III. Para diagnóstico de trastornos funcionales
	Población y muestra	382 alumnos de medicina entre 18 y 25 años.	
Resultados relevantes	Diferencias estadísticamente significativas entre los estudiantes respecto al sexo, etapa académica, antecedentes familiares de SII		

	Diferencia significativa con respecto al rendimiento del ejercicio regular entre los alumnos IBS Y alumnos normales. Diferencia estadísticamente significativa con respecto a la depresión y a la ansiedad mórbida en los subtipos de SII. Una regresión logística multivariante muestra que el SII está significativamente asociado con antecedentes familiares positivos, siendo una mujer, ocurrencia de eventos traumáticos en la infancia y realizar ejercicio regular que demostró ser protector contra el SII
Discusión planteada	En este estudio el ejercicio como habito de estilo de vida fue significativamente protector contra el desarrollo del SII al igual que en los otros estudios. Con respecto a los hábitos alimentarios, en este estudio no se encontró diferencia significativa al igual que los demás estudios a excepción de un estudio de Arabia Saudí.
Conclusiones del estudio	Es probable que los estudiantes de medicina estén sujetos a importantes cantidades de estrés, ansiedad y depresión, los principales factores que pueden explicar la mayor prevalencia de IBS, junto con otros factores. La Sensibilización de los estudiantes con respecto a los síntomas relacionados con el SII y los factores que conducen a su desarrollo probablemente jugaría un papel importante en la mitigación del impacto de la enfermedad en su calidad de vida. Mientras tanto, la reducción de los factores de riesgo y la implementación de estrategias preventivas son importantes para controlar la enfermedad y disminuyendo su efecto indeseable.

N.º Ficha (por orden)	Código de Referencia interna
9	9E

Cita Bibliográfica (Según Vancouver)	1. Yurtdaş G, Acar-Tek N, Akbulut G, Cemali Ö, Arslan N, Beyaz Coşkun A, et al. Risk Factors for Constipation in Adults: A Cross-Sectional Study. J Am Coll Nutr. 2020;39(8):713-9.		
Introducción	***Justificación del artículo***	Los resultados y los datos de estudios que evalúan las relaciones entre el estreñimiento y la ingesta dietética de líquidos y fibra y actividad física son inconsistentes, con resultados a menudo contraindicatorios.	
	Objetivo del estudio	Estudiar las asociaciones entre la actividad física, la fibra dietética, el agua y la ingesta de líquidos, y estreñimiento, así como otros posibles factores de riesgo en adultos	
Metodología	***Tipo de estudio***	Estudio transversal (observacional)	
	Año de realización	2020	
	Técnica recogida de datos	Encuesta/Cuestionario validado	<u>Cuestionario frecuencia alimentaria (FFQ):</u> evalúa fibra dietética y la ingesta de líquidos y agua. El FFQ se modificó considerando los alimentos consumidos con más frecuencia en Turquía para adaptar la dieta turca <u>Actividad física:</u> Cuestionario internacional de actividad física-breve (IPAQ-SF): formulario
		Otros	<u>Medidas antropométricas:</u> bascula electrónica de la marca DR.Mod 85: peso de los participantes. Estadiómetro portátil: medir altura. Índice de masa corporal (IMC).
		Escala (Validada)	Criterios ROMA III
	Población y muestra	4561 adultos de Turquía entre 18 a 65 años.	
Resultados relevantes	La prevalencia de estreñimiento fue mayor en mujeres que en hombres. La prevalencia del estreñimiento aumentó con la edad, desde 12’6 en el grupo de edad de 18 a 29 años a 27’7% en el grupo de 60 a 65 años. Mayor prevalencia de estreñimiento en participantes con sobrepeso.		

	La prevalencia del estreñimiento aumentó con la actividad física, del grupo activo 13’9%, moderadamente activo 14’9% e inactivo 20’6% La prevalencia de estreñimiento fue más alta en los participantes en el cuartil medio inferior de la dieta con ingesta de fibra e ingesta total de líquido entre 1/L. La ingesta de líquidos no se asoció con estreñimiento. Los participantes moderadamente activos, participantes activos tuvieron menor probabilidad de estreñimiento en comparación con los participantes inactivos.
Discusión planteada	Las tasas de estreñimiento en diferentes países pueden verse influenciadas por características sociales, culturales y socioeconómicas, así como por la memoria y el recuerdo subjetivos de datos. Este estudio está de acuerdo con la literatura y es que este estudio también demostró que las mujeres tenían más probabilidades de tener estreñimiento que los Hombres y que generalmente aumenta con la edad. La ingesta total de líquidos no se asoció con el estreñimiento en este estudio
Conclusiones del estudio	Combinando ejercicio físico regular, ingesta adecuada de fibra y agua pueden proteger al individuo del estreñimiento y pueden aliviar los síntomas del estreñimiento.

N.º Ficha (por orden)	Código de Referencia interna
10	10E

Cita Bibliográfica (Según Vancouver)	1. Falcón BS, Sánchez ÁÁ, Diaz-Rubio M, Rey E. Prevalence and factors associated with faecal impaction in the Spanish old population. Age Ageing. 2017;46(1):119-24		
Introducción	***Justificación del artículo***	La asociación entre CC, IF e incontinencia fecal no se ha estudiado en personas mayores que viven en la comunidad.	
	Objetivo del estudio	Objetivo principal de este estudio fue evaluar la prevalencia de IF en la población no institucionalizada mayores de 65 años y los factores asociados. Los objetivos secundarios fueron evaluar la prevalencia de estreñimiento e incontinencia fecal en esta población, para estudiar los factores de riesgo asociados, especialmente la comorbilidad y fármacos, y conocer la relación entre estreñimiento e incontinencia fecal.	
Metodología	***Tipo de estudio***	Estudio descriptivo	
	Año de realización	2017	
	Técnica recogida de datos	Encuesta/Cuestionario validado	<u>Cuestionario validado:</u> resultado con Kappa <u>Ingesta de fibra y actividad física:</u> cuestionarios previamente utilizados en dos estudios.
		Escala (Validada)	Criterios ROMA III
	Población y muestra	1000 personas españolas mayores de 65 años.	
Resultados relevantes	Prevalencia del estreñimiento crónico (CC) 181 personas, incontinencia fecal 56 e impactación fecal 53, de los cuales debido a estreñimiento son 25 personas. **Estreñimiento y factores asociados**: 181 personas conocieron la Roma III criterios para CC, que representa una prevalencia del 18,1%, 166 personas reconocieron el uso regular de laxantes durante el último año, De ellos, 143 personas usaron solo un laxante<u>. Factores asociados</u>: sexo femenino, exfumadores. **IF y factores asociados:** 38 hacia uso de enemas y 15 necesitaban de técnica manual para la extracción. <u>Factores asociados</u>: rango de edad 71 a 80 años, género femenino, estado civil viudo, exfumador, bajo consumo de fibra, actividad física moderada, comorbilidades como la enfermedad de Parkinson, insuficiencia cardíaca, insuficiencia renal y depresión, y consumo de Los AINE.		
Discusión planteada	Estreñimiento crónico (CC) ha surgido como un factor de riesgo independiente para IF, lo que confirma la hipótesis de que IF está asociado a		

	CC. El sexo femenino fue el único factor de riesgo común para ambos CC y FI en el análisis multivariado.
Conclusiones del estudio	La IF afecta a alrededor del 5% de las personas mayores que viven en la comunidad, y es en gran parte no reconocido. El estreñimiento y el género femenino son sus principales factores asociados. Baja actividad física y el número de enfermedades asociadas, especialmente IRC, también juegan un papel importante Papel significativo. El estreñimiento-impactación-incontinencia secuencia no parece ser un fenómeno común en la población no institucionalizada. Otros estudios son necesario para confirmar los factores asociados a IF y evaluar esta secuencia.

N.º Ficha (por orden)	Código de Referencia interna
11	11E

Cita Bibliográfica (Según Vancouver)	1. Moezi P, Salehi A, Molavi H, Poustchi H, Gandomkar A, Imanieh MH, et al. Prevalence of Chronic Constipation and Its Associated Factors in Pars Cohort Study: A Study of 9000 Adults in Southern Iran. Middle East J Dig Dis. 2018;10(2):75-83.		
Introducción	***Justificación del artículo***	Existen estudios sobre la prevalencia de estreñimiento crónico (CC) en irán y especialmente en el sur de Irán, se quiere proporcionar datos de referencia para ensayos futuros adicionales.	
	Objetivo del estudio	Investigar la prevalencia de CC y sus factores asociados en uno de los estudios.	
Metodología	***Tipo de estudio***	Estudio transversal	
	Año de realización	2018	
	Técnica recogida de datos	Encuesta/Cuestionario validado	Cuestionario criterios ROMA IV. Cuestionario internacional de actividad física (IPAQ), las puntuaciones (MET) se clasificaron en: actividad física baja, media y alta.
		Encuesta/cuestionario de elaboración propia	Cuestionario estructurado además del examen físico.
		Registros	Analizaron los datos de referencia del estudio de cohortes pars (PCS).
		Otras	Tabaco: consumo de opio: 1 vez a la semana en los último 6 meses. Alcohol: consumir una vez al mes durante los últimos 6 meses Nivel educativo: analfabetos, menos de 5 años, 6-12 años y universitarios IMC se clasificó según la OMS en subgrupos: peso inferior al normal 18’5, normal18-25, sobrepeso 25 y obeso a partir de 30

	Población y muestra	9.264 sujetos con edades comprendidas entre los 40 y 75 años
Resultados relevantes	752 participantes fueron diagnosticados con estreñimiento crónico (CC). La prevalencia de CC fue del 9,3% para las mujeres y 6,7% para hombres. Prevalencia de CC entre los participantes que tenían 60 años y más se estimó en 11'9%. El participante con menor actividad física tuvo una mayor prevalencia de CC en comparación con los que fueron físicamente más activo 9'1%. Prevalencia de CC fue del 9'1 en participantes con nivel económico y 6'5% para aquellos que estaban en un nivel superior. No hubo relación significativa entre el IMC y el CC. Tabaquismo, opio y alcohol fueron significativamente asociado con CC en hombres. Prevalencia de CC fue significativamente mayor en pacientes con enfermedad cardíaca, accidente cerebrovascular, diabetes mellitus, ansiedad, depresión, dolor de espalda, insomnio, antecedentes de cirugía previa.	
Discusión planteada	La prevalencia estimada en nuestro estudio, al igual que otros estudios realizados en Irán, fue más baja que en los países occidentales. Esto puede deberse a diferentes estilos de vida en la población iraní. En este estudio CC fue más prevalente entre mujeres sexo. También existe una asociación positiva entre la actividad y CC en nuestro estudio. La tasa de CC disminuyó a la mitad en individuos con mayor actividad física en comparación con participantes físicamente inactivos. La prevalencia de estreñimiento fue mayor entre el opio hombres adictos en nuestro estudio. Las limitaciones de nuestro estudio son sus diseño transversal y restricción de edad de 40 a 75 años. En consecuencia, es posible que el estudio no pueda explicar las asociaciones de causa-efecto.	
Conclusiones del estudio	La prevalencia general de estreñimiento es del 8,1% en nuestra población. Los factores más importantes que se asociaron con el estreñimiento en nuestro estudio fueron la edad avanzada, inactividad física, consumo de opio, ansiedad, depresión, insomnio, dolor de espalda o artralgia, y ERGE. Disminuir los factores de riesgo modificables asociados con estreñimiento como el consumo de opio y la inactividad física puede reducir su prevalencia y disminuir la carga de la enfermedad.	

N.º Ficha (por orden)	Código de Referencia interna
12E	12E

Cita Bibliográfica (Según Vancouver)	1. Iftikhar B, Naveed H, Khalil K ur R, ur Rehman H, Khushbaght. Prevalence of Irritable Bowel Syndrome and it's Risk Factors Among Medical Students of Peshawar, Pakistan. Pak J Med Res. 2018;57(1):24-8.		
Introducción	***Justificación del artículo***	El estudio podría resultar útil en nuevos estudios para evaluar el medio ambiente y factores climáticos y podría utilizarse para crear concienciación entre el público en general de Pekistán así como médicos. También puede Ser útil para desviar la atención de las familias de pacientes afectados por la enfermedad para mejorar la salud y el estilo de vida de los pacientes con SII con el fin de tener un mejor resultado de los tratamientos que se están tomando	
	Objetivo del estudio	Estudiar la prevalencia y los factores de riesgo del síndrome del intestino irritable en estudiantes de medicina de Pakistán	
Metodología	***Tipo de estudio***	Estudio transversal (observacional)	
	Año de realización	2018	
	Técnica recogida de datos	Encuesta/Cuestionario validado	Índice de calidad de sueño de Pittsburgh (PSQI): determina calidad de sueño
		Escala (Validada)	DASS 21: evalúa estrés moderado y severo, depresión y ansiedad. Criterios de ROMA III
	Población y muestra	552 estudiantes de 18-25 años	
Resultados relevantes	Entre 552 estudiantes de medicina, 74 tuvieron SII, prevalencia en hombres 13'4% y en mujeres 17'5%. **Asociación de SII con estrés** (severo/alto, moderado y media/baja. • De 551 estudiantes de los cuales 156 (28'3%) tenían estrés severo alto de los cuales el 21'8 era positivo en IBS. • De 336 estudiantes (60'9%) tenían grado moderado de estrés de los cuales el 10'7% era positivo en IBS. • De 60 estudiantes el 10'9% sufrieron bajo nivel de estrés de los cuales el 6'7% era positivo en IBS **Calidad de sueño**: • De 360 estudiantes el 65'2% tenían buena calidad de sueño de los cuales el 10% era positivo en IBS. • Entre 118 estudiantes 21'4% tenía buen grado de sueño del cual el 20'3% era positivo en IBS • Entre 71 estudiantes el 13'$% tenía mala calidad de sueño del cual el 16'2% era positivo en IBS		
Discusión planteada	El género puede ser un factor de riesgo para el SII el estudio muestra que hay mayor prevalencia en mujeres en comparación a los hombres al igual que muestran los resultados de otros estudios sobre médicos en Pakistán, otro estudio mostró		

	prevalencia en mujeres médicas, prevalencia en alumnas de universidades chinas, otro estudio en el Líbano mostró que las mueres tienen más síntomas que los varones. El estudio muestra que la depresión es un factor de riesgo en IBS. Los resultados de nuestro estudio sugieren que los estudiantes con una calidad de sueño regular (20,3%) o mala (16,2%) se encontraron más afectados por este trastorno. En este estudio no se mostraron resultados con respecto a la comida y al ejercicio físico. En este estudio los factores de riesgo común en estudiantes fueron el estrés y la falta de sueño adecuado.
Conclusiones del estudio	Teniendo en cuenta la alta incidencia de SII entre las facultades de medicina y los estudiantes universitarios, Es necesario concienciar a los estudiantes de los posibles resultados negativos de esta condición

N.º Ficha (por orden)	Código de Referencia interna
13	13P

Cita Bibliográfica (Según Vancouver)	1. Gao R, Tao Y, Zhou C, Li J, Wang X, Chen L, et al. Scandinavian Journal of Gastroenterology Exercise therapy in patients with constipation: a systematic review and meta-analysis of randomized controlled trials therapy in patients with constipation: a systematic review and meta-analysis of randomized contr. Scand J Gastroenterol. 2019;54(2):169-77.	
Introducción	***Justificación del artículo***	La relación entre el ejercicio físico y el estreñimiento no está clara, con incertidumbres clave con respecto si el ejercicio puede mejorar el estreñimiento y, de ser así, si ciertos formas, duraciones o intensidades del ejercicio son más capaces de mejorar el estreñimiento.
	Objetivo del estudio	Analizar los efectos de intervenciones de ejercicio sobre el estreñimiento en pacientes afectados.
Metodología	***Tipo de estudio***	Revisión sistemática y metaanálisis
	Año de realización	2019
	Técnica recogida de datos	X
	Población y muestra	Un total de 680 participantes de 9 estudios de los cuales 8 involucraron ejercicio aeróbico y 1 estudio involucró ejercicio anaeróbico.
Resultados relevantes	En total 3345 estudios de los cuales 9 eran ensayos controlados aleatorios. **Efectos del ejercicio aeróbico y anaeróbico en estreñimiento:** → Los resultados de los estudios incluidos mostraron que el ejercicio aeróbico había mejora de los síntomas del estreñimiento → Ejercicio aeróbico: 2 estudios realizaron intervenciones de 180-300min/semana. → 5 estudios la intervención era caminar 60-210 min. → 1 estudio de intervención se hacía 2 veces a la semana con una duración de 80 a 120min por semana. **Efectos de diferentes tipos de ejercicio aeróbico en estreñimiento:** → 2 estudios mostraron que 12 semanas de QiGong mejoraron significativamente los síntomas de estreñimiento en el grupo de intervención en comparación con el grupo control que recibe la atención habitual. → Después de las 12 semanas Baduajin, las cinco dimensiones de calidad de vida (dolor corporal, salud general, vitalidad, rol emocional y salud mental) mejoraron significativamente en el grupo de intervención en comparación con el grupo de comparación que recibió la atención habitual. **Efectos del caminar sobre el estreñimiento:** → 5 estudios evaluaron la intervención de ejercicio que varió de 4 a 12 semanas. los síntomas de estreñimiento mejoraron.	

	→ *Wu y col* encontraron que la eficacia de la caminata diaria de 20 a 30 min fue mejor que la acupuntura, después de 30 días de intervención y 12 meses de seguimiento. → *Yo y col* encontraron mejora de las características de las heces y la hinchazón en la intervención fue mejor que el grupo control. → *Tantawy y col* encontraron que las comparaciones intergrupales mostraron que las pacientes de grupo intervención mostraron mayores mejoras en la calidad de vida, tanto en términos de las aspectos físicos y emocionales. → De Schryver y col. Después de un periodo de 12 semanas de intervención encontraron que los tiempos de tránsito acelerados eran evidentes en el grupo intervención **Efectos del movimiento físico sobre el estreñimiento:** → Jing y col encontraron que después de un periodo de intervención de 8 semanas, comparado con el grupo de control, los síntomas de estreñimiento, el bienestar general, el efecto positivo y el afecto negativos, la experiencia positiva y la experiencia negativa mejoraron significativamente para las personas mayores en enfermería.
Discusión planteada	Esta revisión sistemática y metaanálisis de nueve ensayos controlados encontraron que los síntomas del estreñimiento, la calidad de la vida y el bienestar mejoraron significativamente en los pacientes con estreñimiento después de intervenciones de ejercicio. Entre las intervenciones evaluadas, el ejercicio aeróbico tuvo una significativa impacto positivo en el estreñimiento. Solo un artículo evaluó el ejercicio anaeróbico, encontrando que el entrenamiento de resistencia no afecta los hábitos habituales de ejercicio o los síntomas del estreñimiento de pacientes.
Conclusiones del estudio	Nuestros resultados sugieren que el ejercicio, especialmente el ejercicio aeróbico, puede ser un tratamiento viable y eficaz para pacientes con estreñimiento. Sin embargo, según nuestros hallazgos, no se pueden hacer recomendaciones claras y, como tal, en el futuro Los investigadores deberían diseñar estudios más rigurosos dirigidos a evaluar el impacto del ejercicio en el estreñimiento

N.º Ficha (por orden)	Código de Referencia interna
14	14P

Cita Bibliográfica (Según Vancouver)	1. Huang R, Ho S-Y, Lo W-S, Lam T-H. Physical Activity and Constipation in Hong Kong Adolescents. PLoS One. 2014;9(2):90193.		
Introducción	***Justificación del artículo***	El estreñimiento crónico (CC) ha recibido hasta ahora mucha menos atención de investigación en las poblaciones asiáticas en comparación con las poblaciones occidentales, especialmente los ancianos y las mujeres, Por lo tanto, es importante conocer la magnitud del problema en esta población, así como los factores asociados involucrados, para que se puedan aplicar las medidas preventivas	
	Objetivo del estudio	Estimar la prevalencia de CC y sus factores de riesgo asociados entre las mujeres de 50 años o más en Shanghai, China	
Metodología	***Tipo de estudio***	Estudio transversal (observacional)	
	Año de realización	2017	
	Técnica recogida de datos	Encuesta/Cuestionario validado	Criterios ROMA III
		Encuesta/cuestionario de elaboración propia	<u>Encuesta propia:</u> edad, el índice de masa corporal (IMC), la relación cintura-cadera (WHR), FBG, estado civil, nivel educativo, ocupación actual / pasada, situación menstrual e historial de partos. <u>Hábitos de estilo de vida:</u> tabaquismo y consumo de alcohol, calidad del sueño autoevaluada, estructura de la dieta, frecuencias de consumo de frutas y ejercicio físico.
	Población y muestra	1568 mujeres de 8 comunidades.	
Resultados relevantes	De 1568 mujeres 77 fueron diagnosticadas de CC según los criterios ROMA III. La CC aumentó con la edad con un 4’5% en el grupo de 50 a 59 y Un 6’0% en el grupo de 80%. las Mujeres con CC tenían más posibilidades de tener sobrepeso/obesidad, realizar trabajos no manuales y comer dietas a base de carne, pero es menos probable que realicen ejercicio físico además de estar en el periodo		

	premenopáusico, no tener un historial de parto y sufrir una mala calidad de sueño. **Factores de riesgo asociados a CC:** Hubo asociación de CC con cada variable como son: IMC 25kg/$m^{2,}$ ocupación no Manual, periodo premenopáusico, mala calidad del sueño, historial de parto, dieta base de carne y menos ejercicio físico en población de mujeres en edad de 50 años o más. No se detectó una asociación por la edad, nivel educativo o la diabetes.
Discusión planteada	La cohorte del estudio consistió en mujeres de 50 años o más. en Shanghai, China, una población en la que la prevalencia de CC no se ha estudiado en profundidad anteriormente. De acuerdo con Según los criterios de Roma III, la prevalencia de CC fue del 4,9% en esta población de estudio. Los datos de estudio mostraron que la prevalencia de CC aumentaba con la edad, lo que sugiere que la edad podría no ser un factor de riesgo importante para el estreñimiento en esta población de estudio. Los hábitos de vida deficientes y el bienestar psicológico también se han sugerido como factores de riesgo importantes para el CC.
Conclusiones del estudio	Los resultados de nuestro estudio sugieren que la CC es un trastorno gastrointestinal común. trastorno entre mujeres de 50 años o más en Shanghai, con una prevalencia del 4,9%. Además, IMC ^{3}25,0 kg / m2, la ocupación no manual, el período premenopáusico, la ausencia de historial de partos, la mala calidad del sueño, la dieta a base de carne y el menor ejercicio físico fueron los posibles factores de riesgo de CC en mujeres ancianas

N.º Ficha (por orden)	Código de Referencia interna
15	15B

Cita Bibliográfica (Según Vancouver)	1. Yılmaz S, Calikoglu EO, Kosan Z. for an Uncommon Neurosurgical Emergency in a Developing Country. Niger J Clin Pract. 2019; 22:1070-7.		
Introducción	***Justificación del artículo***	Se sabe poco sobre la prevalencia del SII entre otros miembros de la comunidad en el Medio Oriente, incluida Arabia Saudita.	
	Objetivo del estudio	Este estudio tiene como objetivo documentar la epidemiología del síndrome del intestino irritable y sus factores de riesgo asociados en la región central de Arabia Saudita Arabia.	
Metodología	***Tipo de estudio***	Estudio transversal (observacional).	
	Año de realización	2020	
	Técnica recogida de datos	Encuesta/cuestionario de elaboración propia	cuestionario semiestructurado autoadministrado en línea a través de un formulario de Google.
		Escala (Validada)	<u>Escala (HADS):</u> ansiedad y depresión. Criterios Roma III.
	Población y muestra	426 sujetos entre 14 y 65 años. 230 hombres y 196 mujeres.	
Resultados relevantes	De 426 sujetos la prevalencia de SII fue de 130 personas. Según la HADS la prevalencia de depresión fue de 59 sujetos y de ansiedad 120. 156 trabajaban en el sector público y 123 eran estudiantes. IMC 191 fueron de >25kg/m2. Fumadores 84. Antecedentes de SII 2016. 77 personas beben café, 233 té. 247 duermen menos de 7h al día. 216 comen comida rápida, 201 comen comida picante. 56 realizaban actividad física durante 30min más de 3 veces a la semana. 175 no hacían actividad física. El género, la depresión, la ansiedad y participantes físicamente inactivos mostraron estadísticas significativamente asociadas con IBS sintomático. fumar, antecedentes familiares de SII, sueño inadecuado, frecuentes consumos de comida rápida, comida picante, café, y té. IMC (> 25 kg / m2) y la edad no se mostró significación estadística con IBS.		
Discusión planteada	Este estudio reveló que la prevalencia fue del 30,5%. Esta variación de prevalencia podría ser debido al uso de diferentes criterios de diagnóstico o tal vez debido al a la diferencia entre países en términos de cultura y Hábitos dietéticos. Entendiendo La asociación entre el SII, la ansiedad y la depresión puede ayudar en el tratamiento de los pacientes con SII este estudio. La baja actividad física es estadísticamente significativa con IBS.		
Conclusiones del estudio	Tras el estudio se ve una alta prevalencia de IBS en el centro de Arabia Saudita en la población general con presencia de riesgo con factores que se pueden modificar. El tamaño de la muestra no era lo suficiente grande para poder hacer una evidencia concluyente.		

N.º Ficha (por orden)	Código de Referencia interna
16	16S

Cita Bibliográfica (Según Vancouver)	1. de MENDONÇA APM, Yamashita LM, Silva ED, Solar I, Santos LAO, Vasques ACJ. Nutritional status, quality of life and life habits of women with irritable bowel syndrome: A case-control study. Arq Gastroenterol. 2020;57(2):114-20.	
Introducción	***Justificación del artículo***	Pocos autores han investigado el papel de los hábitos de vida en el desarrollo y los síntomas del SII.
	Objetivo del estudio	Investigar las asociaciones entre calidad de vida, adiposidad corporal, autoinforme de trastornos gastrointestinales síntomas relacionados con alimentos problemáticos y hábitos de vida de los pacientes con IBS, en comparación con un grupo de individuos sanos.
Metodología	***Tipo de estudio***	Estudio de casos y controles.
	Año de realización	2020
	Técnica recogida de datos	Encuesta/Cuestionario validado: cuestionario de calidad de vida del síndrome del intestino irritable" (IBS-QOL). Cuestionario de actividad física (IPAQ) Encuesta/cuestionario de elaboración propia: <u>Cuestionario propio:</u> anamnesis, hábitos de vida, cuestionario de tabaquismo y alcohol, sueño, síntomas gastrointestinales, evaluación calidad de vida y evaluación antropométrica Escala (Validada): El sueño se evaluó en base en la <u>escala de somnolencia de Epworth,</u>
	Población y muestra	70 mujeres con edades entre 20-29 años.
Resultados relevantes	Hubo diferencia significativa en la circunferencia de la cintura y la cadera evidenciando el riesgo enfermedades metabólicas en el grupo de casos en comparación con el de controles. **IMC:** se observó sobrepeso en el grupo de casos mientras que en el gripo de control observamos la eutrofia. **Uso de medicamentos:** grupo de casos mayor frecuencia de comorbilidades asociado con IBS en comparación con el grupo control. **<u>NO asociación significativa</u>** entre el tabaquismo, somnolencia diurna y actividad física con IBS.	

	De 42 alimentos considerados problemáticos que causan agravamientos intestinales 33 alimentos presentaron empeoramiento para los pacientes con SII en comparación con los controles. **Calidad de vida:** fue peor en el grupo de casos que en el control. Hubo peor calidad de vida para los dominios disforia, interferencia con la actividad, la imagen corporal, los problemas de salud, la prevención de alimentos, la reacción social, la sexualidad, las relaciones y en la calidad de vida general para los portadores de IBS, en comparación con el grupo de control.
Discusión planteada	En nuestro estudio investigamos el perfil de adiposidad corporal, vida Hábitos, autoinforme de alimentos problemáticos y calidad de vida. de mujeres con SII en comparación con un grupo de control sano. Los principales hallazgos mostraron que los pacientes con SII presentaban características más generales, adiposidad abdominal y gluteofemoral; mayor frecuencia de comorbilidades y uso de antidiarreicos; menos consumo de alcohol bebidas mayor frecuencia de autoinforme de alimentos problemáticos y exclusión de alimentos de la dieta; y peor calidad de vida cuando en comparación con los controles. Encontramos asociación positiva entre IBS y aumento volumen de grasa androide, según la circunferencia de la cintura, y ginoides, según la circunferencia de la cadera, y grasa general según al IMC.
Conclusiones del estudio	el SII se asoció con adiposidad corporal, dolor crónico trastornos, restricción de alimentos, menor consumo de bebidas alcohólicas y peor calidad de vida en comparación con individuos sanos, sugiriendo así una demanda de atención de salud multidisciplinar hacia esta población.

N.º Ficha (por orden)	Código de Referencia interna
17	17EA

Cita Bibliográfica (Según Vancouver)	1. Lis DM, Stellingwerff T, Kitic CM, Fell JW, Ahuja KDK. Low FODMAP: A Preliminary Strategy to Reduce Gastrointestinal Distress in Athletes. Med Sci Sports Exerc. 2018;50(1):116-23.	
Introducción	***Justificación del artículo***	En los atletas buscan reducir los síntomas gastrointestinales, los datos autoinformados indican que más de la mitad elimina los alimentos con alto contenido de FODMAP (HFOD).
	Objetivo del estudio	Examinar el efecto de una dieta LFOD versus una dieta HFOD en síntomas de malestar gastrointestinal autoinformado y bienestar percibido en competitivos recreativos clínicamente saludables corredores con antecedentes de síntomas gastrointestinales.
Metodología	***Tipo de estudio***	Diseño experimental
	Año de realización	2017
	Técnica recogida de datos	Encuesta/cuestionario de elaboración propia Cuestionario de demandas (DALDA): un cuestionario gastrointestinal diario y un análisis diario de la vida
	Población y muestra	11 corredores competitivo-recreativos (925 km corriendo por semana) de 18 a 50 años
Resultados relevantes	Síntomas gastrointestinales: las respuestas individuales muestran que el 82% de los participantes tenían menos síntomas gastrointestinales diarios durante el LFOD en comparación con HFOD. En grupo también fue menor los síntomas gastrointestinales diarios específicos que se redujeron durante LFOD incluyendo flatulencia, urgencia de defecar, heces blandas y diarrea. NO se observaron efecto de orden o periodo para síntomas de GI diarios totales, durante el ejercicio a excepción de heces blancas.	
Discusión planteada	Los resultados de este preliminar estudio indican que una dieta LFOD tuvo un efecto positivo en la Síntomas gastrointestinales en el 82% de los participantes. En participantes con síntomas gastrointestinales persistentes asociados con el ejercicio, 9 de los 11 informaron de una reducción de los síntomas gastrointestinales diarios con una dieta LFOD a corto plazo. Es interesante considerar si el estrés fisiológico, mecánico y nutricional único que enfrentan los atletas de resistencia podría aumentar la susceptibilidad a cualquier desencadenante dietético, como FODMAP, para algunos de estos atletas. Los síntomas gastrointestinales diarios con la dieta LFOD fueron menores en comparación con HFOD. puede ser necesario un período más largo de LFOD para aumentar mayor reducción de los síntomas. El ejercicio y la dieta de un atleta pueden ofrecer una protección elemento contra una disminución en las poblaciones de bacterias intestinales sanas asociadas con la restricción de FODMAP.	
Conclusiones del estudio	Los resultados de este estudio han demostrado que a corto plazo LFOD da como resultado síntomas gastrointestinales diarios significativamente más	

	bajos durante el período de intervención en comparación con una dieta HFOD en atletas con antecedentes autoinformados de malestar gastrointestinal asociado al ejercicio persistente, Malestar gastrointestinal asociado al ejercicio y La fisiopatología del SII. Ambas afecciones presentan una sintomatología similar. Aunque, es necesario más Trabajo para determinar la eficacia de una dieta LFOD, Los hallazgos preliminares sugieren que este enfoque dietético puede ser aplicable más allá del ámbito clínico y ofrecer una novedad estrategia para reducir los síntomas gastrointestinales.

N.º Ficha (por orden)	Código de Referencia interna
18	18BA

Cita Bibliográfica (Según Vancouver)	1. Eswaran S, Chey WD, Jackson K, Pillai S, Chey SW, Han-Markey T. A Diet Low in Fermentable Oligo-, Di-, and Monosaccharides and Polyols Improves Quality of Life and Reduces Activity Impairment in Patients With Irritable Bowel Syndrome and Diarrhea. Clin Gastroenterol Hepatol. 2017;15(12):1890-1899.e3.		
Introducción	***Justificación del artículo***	¿Cuáles serían las recomendaciones dietéticas estándar para el síndrome del intestino irritable?	
	Objetivo del estudio	Averiguar qué dieta baja en FODMAP mejora la calidad de vida específica de la enfermedad, angustia psicológica, productividad laboral y dormir en mayor grado.	
Metodología	***Tipo de estudio***	Ensayo controlado aleatorizado	
	Año de realización	Entre octubre de 2010 y noviembre de 2015	
	Técnica recogida de datos	Encuesta/Cuestionario validado	<u>cuestionario IBS-QOL:</u> evaluar ansiedad y depresión. Cuestionario ROMA III
		Escala (Validada)	<u>Escala (HADS):</u> productividad y la actividad del Trabajo. Escala de calificación para el sueño.
	Población y muestra	88 pacientes entre 19-75 años	
Resultados relevantes	En la dieta baja en FODMAP hubo mejoras en el hinchazón, consistencia, frecuencia y urgencia que en el grupo mNICE. Calidad de vida: en el grupo FODMAP hubo mejoría en los dominios de disforia, interferencia con la actividad, imagen corporal y reacción social. Se mejoró la ansiedad con la dieta baja en FODMAP, pero no hubo asociación con la depresión. A nivel de deterioro de la productividad y la actividad laboral la magnitud del beneficio informado por el grupo bajo en FODMAP fue significativamente mayor que el informado por el grupo mNICE. En comparación con la línea base, la media de sueño y fatiga las puntuaciones mejoraron a las 4 semanas para el grupo bajo en FODMAP.		
Discusión planteada	la dieta baja en FODMAP condujo a Mejoras significativas en la calidad de vida, la ansiedad y la actividad. deterioro en comparación con una intervención dietética basada en Directrices de mNICE. Se utilizaron un grupo de dietistas de investigación capacitados para instruir a los participantes del estudio sobre las intervenciones dietéticas con la esperanza de reducir la probabilidad de introducir sesgos hacia una intervención u otra.		
Conclusiones del estudio	la dieta baja en FODMAP es un tratamiento efectivo intervención para pacientes con IBS-D.		

N.º Ficha (por orden)	Código de Referencia interna
19	19BE

<table>
<tr><td>Cita Bibliográfica (Según Vancouver)</td><td colspan="2">1. Wiffin M, Smith L, Antonio J, Johnstone J, Beasley L, Roberts J. Effect of a short-term low fermentable oligosaccharide, disaccharide, monosaccharide and polyol (FODMAP) diet on exercise-related gastrointestinal symptoms. Disponible en: https://doi.org/10.1186/s12970-019-0268-9</td></tr>
<tr><td rowspan="4">Introducción</td><td>Justificación del artículo</td><td>hay una escasez de investigaciones que exploren el potencial Beneficio de las estrategias FODMAP para apoyar a atletas recreativos saludables que experimentan problemas gastrointestinales durante la resistencia.</td></tr>
<tr><td>Objetivo del estudio</td><td>Investigar el efecto percibido de la ingesta aguda de FODMAP sobre la gravedad de los síntomas gastrointestinales y la capacidad de ejercicio en atletas recreativos en condiciones de vida libre condiciones</td></tr>
<tr><td rowspan="3">Metodología</td><td>Tipo de estudio</td><td>Ensayo cruzado aleatorio</td></tr>
<tr><td>Año de realización</td><td>2019</td></tr>
<tr><td>Técnica recogida de datos</td><td>
<table>
<tr><td>Encuesta/cuestionario de elaboración propia</td><td>Cuestionario de síntomas.</td></tr>
<tr><td>Escala (Validada)</td><td>Escala analógica EVA</td></tr>
<tr><td>Otras</td><td>Muestra de sangre en ayunas.
Escala para calificar intensidad de ejercicio.
Diario de alimentos.</td></tr>
</table>
</td></tr>
<tr><td>Población y muestra</td><td>16 atletas (10 mujeres y 6 hombres)</td></tr>
<tr><td>Resultados relevantes</td><td colspan="2">Las respuestas individuales indicaron que el 69% de los participantes informaron efectos positivos de la dieta BAJA FODMAP, en contraste con el 25% en la dieta HIGHFODMAP dieta.
<u>Individualmente:</u> todos los síntomas, excepto el estreñimiento y la defecación, registraron una disminución en la puntuación en el LOWFODMAP, mientras que todos los síntomas excepto la flatulencia registró un aumento en la puntuación en la dieta HIGHFODMAP
Ejercicio: Los participantes eran más propensos a informar que la capacidad de ejercicio había mejorado con una dieta LOWFODMAP y se deterioró con una dieta HIGHFOD MAP.</td></tr>
<tr><td>Discusión planteada</td><td colspan="2">Un enfoque LOWFODMAP pareció dar como resultado puntuaciones mejoradas para la mayoría de los síntomas individuales, solo las respuestas al dolor y la hinchazón percibidos fueron significativamente diferente entre las condiciones que siguen a las intervenciones dietéticas. Una observación interesante del estudio actual fue la percepción mejorada de la frecuencia y la intensidad del ejercicio por parte de los participantes mientras realizaban el enfoque LOW FODMAP. Aunque esto solo reflejó cambios percibidos en el corto plazo (7 días), esto puede tener implicaciones para enfoques sostenidos donde las rutinas de entrenamiento pueden verse interrumpidas (incluido el volumen y la intensidad) debido a problemas relacionados con el GI.</td></tr>
</table>

Conclusiones del estudio	Este estudio proporciona evidencia de que los atletas recreativos que implementan un LOW FODMAP a corto plazo la dieta en condiciones de vida libre puede experimentar beneficios en los síntomas gastrointestinales relacionados con el ejercicio y mejoras percibidas en la intensidad y frecuencia del ejercicio. Sin embargo, se debe tener precaución para minimizar las reducciones innecesarias en la ingesta total de calorías y / o carbohidratos que puede afectar la calidad nutricional

N.º Ficha (por orden)	Código de Referencia interna
20	20P

Cita Bibliográfica (Según Vancouver)	1. Mearin F, Ciriza C, Mínguez M, Rey E, Mascort JJ, Peña E, et al. Clinical practice guidelines: Irritable bowel syndrome with constipation and functional constipation in adults: Concept, diagnosis, and healthcare continuity. (Part 1 of 2). Aten Primaria. 2017;49(1):42-55.	
Introducción	***Justificación del artículo***	No hay justificación.
	Objetivo del estudio	Analizar los criterios de alarma, las pruebas diagnósticas y los criterios de derivación entre atención primaria y aparato digestivo.
Metodología	***Tipo de estudio***	Guía de práctica clínica
	Año de realización	2017
	Técnica recogida de datos	No se utilizan recogida de datos.
	Población y muestra	No hay muestras.
Información relevante	• Definición síndrome de intestino irritable. • Definición estreñimiento funcional. • Definición síndrome intestino irritable con estreñimiento. • Importancia social clínica y económica de SII-E y estreñimiento funcional. • Diferencias y semejanzas entre ambas enfermedades. • Diagnóstico • Utilidad clínica. • Niveles asistenciales • Exploraciones complementarias	

FICHA REVISIÓN BIBLIOGRÁFICA

N.º Ficha (por orden)	Código de Referencia interna
21	21P

Cita Bibliográfica (Según Vancouver)	1. Mearin F, Ciriza C, Mínguez M, Rey E, Mascort JJ, Peña E, et al. Guía de Práctica Clínica. Síndrome del intestino irritable con estreñimiento y estreñimiento funcional en adultos. Tratamiento (Parte 2). Med Gen y Fam. 2017;6(2):69-85.	
Introducción	***Justificación del artículo***	No hay justificación.
	Objetivo del estudio	analizar le manejo diagnóstico y terapéutico de los pacientes adultos con estreñimiento y molestias abdominales (síndrome de intestino irritable y estreñimiento funcional)
Metodología	***Tipo de estudio***	Guía de práctica clínica
	Año de realización	2017

	Técnica recogida de datos	No se utilizan recogida de datos.
	Población y muestra	No hay muestras.
Información relevante	• Tratamiento. • Utilidad del ejercicio físico aeróbico. • Ingesta de líquidos. • Utilidad de distintas dietas. • Laxantes, enemas, probióticos y antibióticos. • Suplementos de fibra. • Antidepresivos. • Tratamiento psicológico.	

N.º Ficha (por orden)	Código de Referencia interna
22	22P

<table>
<tr><td>Cita Bibliográfica (Según Vancouver)</td><td colspan="3">1. Kouamé A, Paulin M, Aboubacar CE, Bangoura D, Attia AK. The burden of irritable bowel syndrome and chronic constipation on health-related quality of life in black Africans: a comparison with healthy control subjects in Côte d’Ivoire, West Africa. 2019;</td></tr>
<tr><td rowspan="5">Introducción</td><td>Justificación del artículo</td><td colspan="2">No hay datos que reporten la magnitud de Deterioro de la calidad de vida relacionada con la salud (CVRS) en sujetos africanos negros con SII o EC en comparación con la de los controles sanos. Los síntomas se superponen entre SII y EC como los sujetos con EC pueden experimentar ocasionalmente más síntomas abdominales severos (malestar e hinchazón) que los sujetos con SII-C lo que sugiere una puntuación fluctuante de CVRS según el inicio de los síntomas</td></tr>
<tr><td>Objetivo del estudio</td><td colspan="2">1. Determinar la CVRS en sujetos negros africanos con SII o EC, comparada con la de los controles sanos.
2. Evaluar los factores asociados con las dimensiones físicas y mentales deterioro de la CVRS en pacientes con SII y EC en el entorno africano
3. Saber El papel del dolor abdominal en el paciente con EC.</td></tr>
<tr><td rowspan="4">Metodología</td><td>Tipo de estudio</td><td colspan="2">Estudio de casos y controles</td></tr>
<tr><td>Año de realización</td><td colspan="2">De marzo a septiembre de 2016</td></tr>
<tr><td>Técnica recogida de datos</td><td>Encuesta/Cuestionario validado</td><td>Cuestionario SF-36: preguntas que describían el impacto de las enfermedades o discapacidades en el estado de bienestar</td></tr>
<tr><td></td><td>Encuesta/cuestionario de elaboración propia</td><td>Cuestionario propio: constaba de tres secciones que recuperaban datos sociales y demográficos, datos clínicos y elementos</td></tr>
<tr><td></td><td>Escala (Validada)</td><td>Escala Bristol</td></tr>
<tr><td>Población y muestra</td><td colspan="2">104 pacientes africanos negros (SII 72 mujeres y CC 32 hombres) + 210 sujetos control.</td></tr>
<tr><td>Resultados relevantes</td><td colspan="3">CC y SII se encontrarán en mujeres en 62’2% y 75%

Post cuestionario SF-36
→ Los pacientes con IBS tenían un Puntuación compuesta física (PSC) bajo en comparación con los pacientes con CC.</td></tr>
</table>

	→ Hubo una tendencia de PCS y puntuación compuesta mental (MCS) que desfavorecen a los pacientes con IBS en comparación con pacientes CC y sujetos control. → Pacientes con SII puntuó menos en el dominio de salud mental (MH) <u>Influencia del dolor abdominal en el CVRS en pacientes con CC en comparación con SII.</u> → Entre los 32 pacientes con EC, 21 (65,6%) se quejaron sobre el dolor abdominal. No hubo diferencias entre edad y sexo entre grupos → PCS Y MCS fueron significativamente diferentes entre los pacientes con SII y los subgrupos de pacientes sin dolor y EC dolorosa → pacientes con IBS exhibieron una significativa deterioro de la CVRS tanto en su aspecto físico y mental**.** Los pacientes con EC sin dolor LA PSC Y MCS eran normales. <u>Factores que influyen en la CVRS entre pacientes con EC y SII en comparación con sujetos control.</u> → los factores que redujeron el PCS fueron las comorbilidades, SII y EC y el factor potenciador fue el IMC. → Para MCS los factores de reducción fueron SII y los factores potenciadores fueron actividad remunerada y paciente que vive solo
Discusión planteada	Se ha demostrado en este estudio que los africanos negros los pacientes con SII y estreñimiento crónico presentan una baja CVRS en comparación con los sujetos control. los factores que afectan la CVRS fueron el IMC, estado civil, y la presencia de personas remuneradas actividad. SII y EC pueden alterar tanto físicos como mentales dimensiones del estado de bienestar y, lo que es más importante, en Sujetos con SII que pueden provocar ansiedad y depresión como reportados en sujetos con SII nigerianos.
Conclusiones del estudio	SII y estreñimiento crónico impactan negativamente en el CVRS en sujetos africanos negros en y más importante en aquellos con SII-E. La evaluación de La CVRS se puede utilizar para distinguir entre sujetos SII-E y aquellos con estreñimiento crónico dolorosa con el fin de motivar el uso del tratamiento más psicológico en el primero en un entorno africano.

N.º Ficha (por orden)	Código de Referencia interna
23	23E

Cita Bibliográfica (Según Vancouver)	1. Gandy OH. Coming to Terms with Chance. Coming to Terms with Chance. 2016;	
Introducción	***justificación***	No hay justificación
	Objetivo del estudio	No hay objetivo
Metodología	***Tipo de estudio***	Artículo del blog de facultad de medicina de Harvard. *(Harvard health blog – Live a healthier lifestyle)*
	Publicación	2016
	Técnica recogida de datos	No se utilizan recogida de datos.
	Población y muestra	No hay muestras.
Información relevante	• Causas del estreñimiento. → Inadecuada fibra (se recomienda 25gr diarios) → Medicación (antidepresivos, calmantes y medicamentos para la incontinencia). → Poco ejercicio • Tratamiento esporádico del estreñimiento. → Incremento de fibra en la dieta → Laxantes → Ejercicio (estimula las contracciones del colon), masaje abdominal y perineal, levantar las rodillas por encima de las caderas al ir al aseo) La interacción entre el sistema nervioso y el sistema digestivo (Parkinson, lesión medular, accidente cerebrovascular, etc) puede causar estreñimiento. Personas con déficit de contratación de los músculos de suelo pélvico también pueden padecer de estreñimiento.	

N.º Ficha (por orden)	Código de Referencia interna
24	24P

Cita Bibliográfica (Según Vancouver)	1. Cassidy T, Fortin A, Kaczmer S, Shumaker JTL, Szeto J, Madill SJ. Pelvic-Floor Dysfunction Special Issue. Phys Ther. 2017;97(4):449-54.	
Introducción	***justificación***	No hay justificación
	Objetivo del estudio	Aumentar la consciencia y el manejo del estreñimiento crónico por parte de los fisioterapeutas y estimular el cuestionamiento clínico para abrir vías de investigación para mejorar la atención al paciente.
Metodología	***Tipo de estudio***	Artículo de revista. *Oxford academic, PTJ physical therapy & rehabilitation journal.*
	Publicación	2017
	Técnica recogida de datos	No se utilizan recogida de datos.
	Población y muestra	No hay muestras.
Información relevante	Ejemplos de tratamiento en fisioterapia: Paciente A: impulsos infrecuentes de defecar (heces duras y pequeñas), dolor abdominal, y distensión abdominal, indigestión de comidas. Fisioterapia: masaje abdominal, se cree que estimula la hernia, disminuye el tiempo de tránsito colónico y aumentar la frecuencia de la evacuación intestinal educación (hábitos de ir al baño) y recomendaciones. Paciente B: evacuaciones poco frecuentes, sensación de vacío incompleto, incapacidad de evacuar. Fisioterapia: reentrenamiento sensorial rectal, fortalecimiento abdominal y pared diafragmática. Esto ayudó a la paciente para aprender y ejecutar la defecación. El fisioterapeuta es capaz de realizar un examen neuromuscular y tratar aquellos pacientes que presentar síntomas de estreñimiento funcional y SII. Mediante los ejemplos del paciente A y B existe evidencia para apoyar ciertas intervenciones realizadas por un fisioterapeuta.	

PLOS ONE

RESEARCH ARTICLE

The effects of locomotor activity on gastrointestinal symptoms of irritable bowel syndrome among younger people: An observational study

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Citation: Hamaguchi T, Tayama J, Suzuki M, Nakaya N, Takizawa H, Koizumi K, et al. (2020) The effects of locomotor activity on gastrointestinal symptoms of irritable bowel syndrome among younger people: An observational study. PLoS ONE 15(5): e0234089. https://doi.org/10.1371/journal.pone.0234089

Editor: Subas Neupane, University of Tampere, FINLAND

Received: November 29, 2019

Accepted: May 18, 2020

Published: May 29, 2020

Peer Review History: PLOS recognizes the benefits of transparency in the peer review process; therefore, we enable the publication of all of the content of peer review and author responses alongside final, published articles. The editorial history of this article is available here: https://doi.org/10.1371/journal.pone.0234089

Data Availability Statement: All relevant data are within the paper and its Supporting Information files.

Abstract

Irritable bowel syndrome (IBS) is a common bowel disorder that manifests as unexplained abdominal pain or discomfort and bowel habit changes in the form of diarrhea, constipation, or alternating patterns of the two. Some evidences demonstrate that increased physical activity improves IBS symptoms. Hence, daily exercise is recommended in these patients. In this study, we aimed to investigate the relationship between physical activity and gastrointestinal symptoms in 101 university students (female = 78) with IBS. Participants were examined by Gastrointestinal Symptoms Rating Scale (GSRS), and gait steps were measured for 1 week using a pedometer. The association between the GSRS score and pedometer counts was determined by ordinal logistic modeling analysis. The ordinal logistic regression model for GSRS and locomotor activity showed a significant stepwise fit ($z = -3.05$, $p = 0.002$). The logistic curve separated GSRS score of 5 points (moderately severe discomfort) from 2 points (minor discomfort) by locomotor activity. The probability for daily locomotor activity to discriminate between 5 and 4 points of GSRS (i.e., likely to have reverse symptoms) decreased in accordance with increment of steps per day: 78% probability for 4000 steps, 70% probability for 6000 steps, 59% probability for 8000 steps, and 48% probability for 10000 steps. This study demonstrated that the severity of GSRS is associated with the amount of walking in younger people with IBS. These results may be used as a measure to determine the daily step count to reduce the severity of gastrointestinal symptoms in individuals with IBS.

Introduction

Irritable bowel syndrome (IBS) is a common bowel disorder that manifests as unexplained abdominal pain or discomfort and bowel habit changes in the form of diarrhea, constipation,

Funding: The Japan Society for the Promotion of Science funded this research through grants (project JP10K11368 and JP18KK0275). Staff at Saitama Prefectural University provided support for this study through subject recruitment, material procurement, and funding management.

Competing interests: The authors have declared that no competing interests exist.

or alternating patterns between the two [1, 2]. IBS is associated with reduced quality of life [3, 4], which may affect every day living activities. IBS is reportedly common in Japanese adults and is more prevalent in younger age females with low body mass index (BMI) [5]. We followed the treatment guidelines developed by the Japanese committee of Gastroenterology [6]. As some patients prefer non-medical management through diet and physical activity [7, 8], lifestyle modification is considered the initial management for IBS. A previous study has shown that increased physical activity improves gastrointestinal (GI) symptoms in patients with IBS [9]. In the National Health Promotion Movement in the 21st Century in Japan (Health Japan 21), the recommended amount of daily activity is equivalent to 9000 steps for men and 8500 steps for women aged 20–64 years [10]. Thus, it is desirable to achieve these targets in IBS patients.

Previous studies have reported that after a 12-week intervention, GI symptoms improved in physically active patients with IBS compared with physically inactive patients [7, 11]. Brief yoga poses and breathing intervention were feasible and safe adjunctive treatments in young patients with IBS, leading to reduced pain and GI symptoms [12]. Moreover, the IBS group had significantly improved symptoms of constipation compared to the usual care group at a 12-week follow-up after exercise [9]. Hence, physical exercise may be effective in attenuating IBS symptoms temporarily.

Adolescents reportedly present with a variety of IBS symptoms [13, 14] and physical activities [15, 16]. If the relationship between the severity of IBS symptoms and the amount of physical activities can be clarified, then the minimum amount of daily exercise to reduce IBS symptoms can be determined. However, to the best of our knowledge, no study has reported on the extent of the effects of daily activity on improving the GI symptoms of IBS. The research question of how activity level influences symptom severity is important to the management of IBS symptoms. Thus, we aimed to investigate the relationship between physical activity and GI symptoms among younger people with IBS and to estimate the extent of GI symptoms attenuated by achieving the recommended amount of daily activity as per Health Japan 21 [10].

Methods

Study design and ethical considerations

This was an observational study. This study was approved by the Ethics Committee in Saitama Prefectural University (No. 27157) and was conducted in accordance with the Declaration of Helsinki. Participants were informed that the purpose of this study was to investigate the relationship between GI symptoms and physical activity among participants with IBS during the informed consent procedure. Furthermore, they were instructed to measure their physical activity for 1 week using a Pedometer (LifeCorder GS, Suzuken, Tokyo), and to wear the pedometer for 1 week (except when taking a bath), and also to perform their daily life activities.

Participants

The inclusion criteria for study participants were as follows: (1) university students >20 years old and (2) students diagnosed with IBS symptoms according to Rome III criteria: recurrent abdominal pain or discomfort associated with two or more of the following: 1) improvement with defecation; and/or, 2) onset associated with a change in frequency of stool; and/or 3) onset associated with a change in form (appearance) of stool for at least 3 months in the last 6 months [17]. The exclusion criteria were (1) students taking medication for IBS treatment 12 weeks prior to the start of the study and (2) students in whom locomotor counts for 1 week could not be measured. The number of participants required for the analysis of this study was

67 as calculated by G* power [18], logistic regression a priori with an effect size of 0.8, an alpha error of 0.05, and a power of 0.8.

Data collection

From 2015 to 2018, we distributed 1240 copies of survey cooperation requests to university students annually between October to January. In this study, university students were recruited to investigate the relationship between IBS symptoms and physical activity, from autumn to winter. A request for recruiting collaborators in the survey was created, posted on the university bulletin board, and distributed to university students after class. A school medical doctor interviewed the students who read the distributed survey request form and confirmed the presence or absence of IBS symptoms according to the Rome III criteria.

The Rome III criteria are used to diagnose IBS symptoms, which include recurrent abdominal pain or discomfort, 3 days per month in the last 3 months (12 weeks), and are associated with two or more of the following three criteria: 1) improvement with defecation, 2) the onset is associated with a change in stool frequency, and 3) the onset is associated with a change in the stool form (appearance). To fulfil the criteria, symptom onset should occur 6 months prior to the diagnosis.

Informed consent forms were given to students who had IBS symptoms, and consent to measure the number of steps in 1 week and to investigate GI symptoms using the Gastrointestinal Symptoms Rating Scale (GSRS) [19, 20] was obtained. The GSRS is a disease-specific instrument of 15 items combined into 5 symptom clusters depicting reflux, abdominal pain, indigestion, diarrhea, and constipation. The GSRS has a seven-point graded Likert-type scale where "1" represents the absence of troublesome symptoms and "7" represents very troublesome symptoms.

Students responding to the survey carried pedometers (LifeCorder GS, Suzuken, Tokyo) about for 1 week, after which each individual's weekly walking activity and digestive symptom scores were analyzed. Walking activity data that were recorded in LifeCorder GS were uploaded into a personal computer using an application Lifelyzer05 (Kenz, Tokyo). Participant's GI symptoms were examined using the GSRS after pedometer counts.

Statistical analysis

Participants' age, sex, physical activity, and GI symptoms were compared according to sex using $\chi 2$ test and Student's t-test. The GSRS scores were derived from the total score and divided by 15 (i.e. the 15 item subscales). The average pedometer counts (steps/day) were calculated using all days of data collection. The association between the GSRS score and pedometer counts was determined by the ordinal logistic modeling analysis [21]. The relationship between GSRS score and pedometer counts (prediction probability $g(x)$) was estimated using ordinal logistic regression modeling (Eq 1) with the dependent variable as GSRS score ($f(x)$, continuous variates 1 to 7) and the independent variable as pedometer counts for x (Eq 2). The principle of ordinal logistic regression modeling is to fit the probability (P) of multiple dichotomous responses (Eq 1):

$$g(x) = \frac{1}{1 + e^{-f(x)}} \tag{1}$$

$$f(x) = \beta_0 + \beta_1 x + e \tag{2}$$

where x is the explanatory variable, β_i is the partial regression coefficient, and e is the residual between actual and predicted data. Therefore, for multilevel ordinal responses, the cumulative

probability is calculated at each level to generate a simple regression. In this study, the probability of the cut-off point for each level of severity of GI symptoms based on the GSRS score (1|2, 2|3, 3|4, 4|5) was evaluated in association with the pedometer count. A sub-analysis was performed to investigate any gender difference. The level of statistical significance was set at 5%. All statistical analyses were performed using the R 3.5.2 software (R Foundation for Statistical Computing, Vienna, Austria).

Results

Of 663 participants who consented to enter the study, 103 university students (80 female) were diagnosed by school medical doctors to have IBS symptoms based on the Rome III criteria [17, 22], none of whom were taking medications for IBS. Of the 103 participants, two were excluded before the analysis because the step counts were not measured every day. Finally, data from 101 participants (female = 78) were analyzed (Fig 1). IBS subtypes, based on the frequency of symptoms in the participants, were constipation (n = 42), mixed type (n = 29), diarrhea (n = 25), and not classified (n = 5). All 101 participants completed the one-week step count and GSRS survey. The number of female students with IBS was higher than that of male students ($x^2 = 3.36$, $p < 0.01$, V = 0.04). The BMI was 23 ± 3 for female participants and 21 ± 2 for male participants. No sex differences in age, one-week step count, and GSRS score were found (Table 1).

Scatterplots of GSRS score and locomotor activity of the participants are presented in Fig 2a. The ordinal logistic regression model for GSRS and locomotor activity showed a significant stepwise fit (z = -3.05, $p = 0.002$; Fig 2b). The GSRS ranges from severe, to moderate, to minor discomfort. The threshold estimate assigned to severe is GSRS score of 5, to moderate GSRS score of 3 and to minor discomfort GSRS score of 2. Locomotor activity was a significant predictor in separating these thresholds with the estimate assigned to this logistic curve.

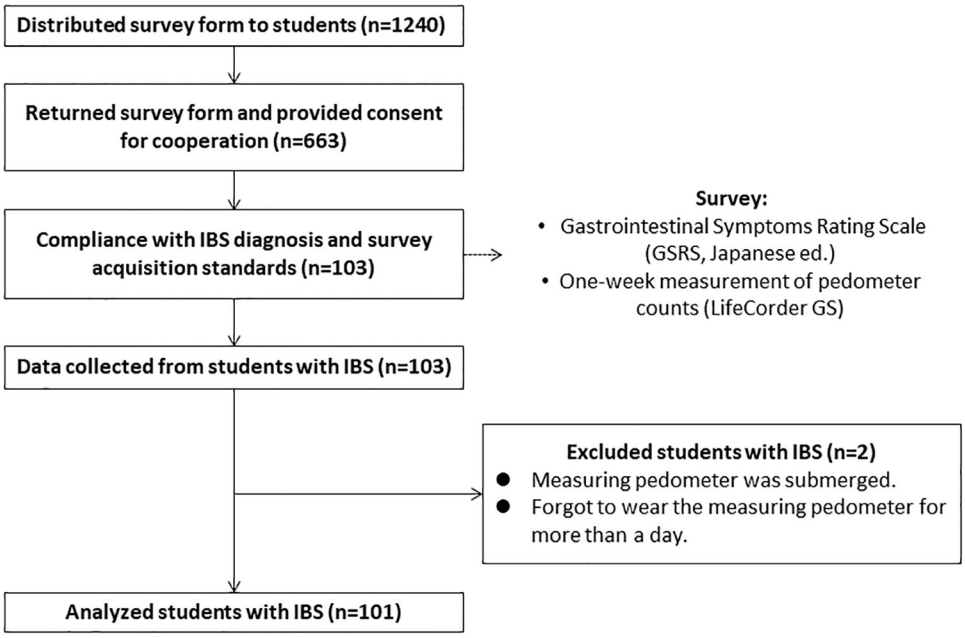

Fig 1. Selection process of the study population and study design. The survey was distributed to a total of 1240 university students during the study period. Data from 101 students who met the inclusion criteria were collected and statistically analyzed.

https://doi.org/10.1371/journal.pone.0234089.g001

Table 1. Participant characteristics.

	All	Female	Male	Statistics		
Participants (n)	101	78	23	$x^2 = 3.36$	$p < 0.01$	V = 0.12
Age (years)	20 ± 2	20 ± 2	20 ± 2	t = -0.59	$p = 0.56$	$d = 0.09$
Locomotor	8126 ± 2570	7627 ± 2426	8272 ± 2608	t = 1.37	$p = 0.31$	$d = 0.26$
GSRS score	2.6 ± .9	2.6 ± .9	2.7 ± .8	t = -0.77	$p = 0.44$	$d = 0.11$

The locomotor activity is the number of daily step counts measured using a LifeCorder GS pedometer that participants carried for 1 week. The Gastrointestinal Symptoms Rating Scale (GSRS) score is adjusted by dividing the total score by the number of questions.

https://doi.org/10.1371/journal.pone.0234089.t001

Probability for daily locomotor activity to discriminate between GSRS scores 5 and 4 (i.e., likely to have severe symptoms) was decreased in accordance with increment of steps per day: 78% probability for 4000 steps, 70% probability for 6000 steps, 59% probability for 8000 steps, and 48% probability for 10000 steps (Fig 2b and S1 Table).

Sub-analysis was performed separately to determine sex differences. We did not observe any significant difference in the results of the ordinal logistic regression analysis for the male participants (z = -1.81, $p = 0.07$), while that of female participants showed a significant difference (z = -2.44, $p = 0.01$), which was similar to the overall results of the ordinal logistic regression analysis (Fig 3). Probability for daily locomotor activity to discriminate between GSRS scores 5 and 4 was decreased in accordance with increment of steps per day: 79% probability for 4000 steps, 71% probability for 6000 steps, 62% probability for 8000 steps, and 52% probability for 10000 steps in female participants (Fig 3b). Especially, probability for daily locomotor activity to discriminate between GSRS scores 5 and 4 was 60% probability for 8500 steps per day in reference to necessary daily steps in healthy females recommended by the Health Japan 21 (S2 Table). [10]

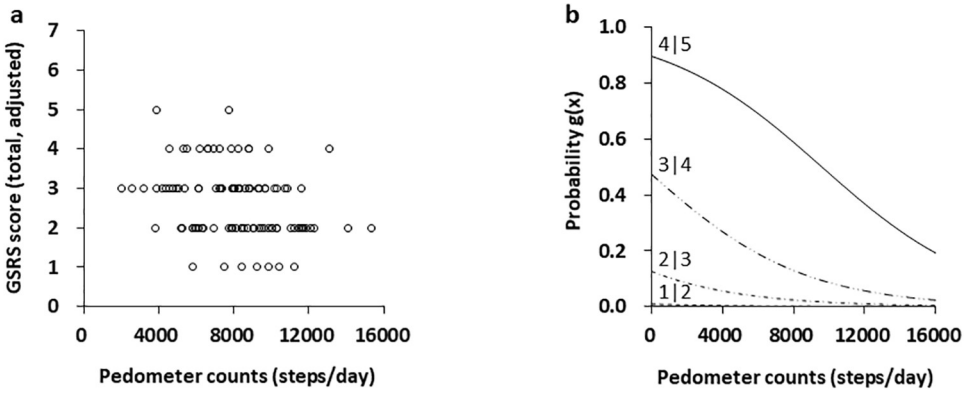

Fig 2. Logistic probability plots of the relationship between GSRS score and pedometer counts. (A) Scatterplots of Gastrointestinal Symptoms Rating Scale (GSRS) scores and daily pedometer counts in university students with IBS (n = 101). GSRS scores range from 7 indicating "very severe discomfort" to 1 "no discomfort at all." Plots were realigned by GSRS scores and the one-week pedometer counts in participants with irritable bowel syndrome (IBS). (B) Logistic curves separated by GSRS scores of 5 (moderately severe discomfort) and 2 (broken line: minor discomfort), GSRS scores of 5 and 4 (solid line), and GSRS scores of 4 and 3 (chain line) were in a stepwise fit. Ordinal logistic regression model, z = -3.05, stepwise fit $p = 0.002$.

https://doi.org/10.1371/journal.pone.0234089.g002

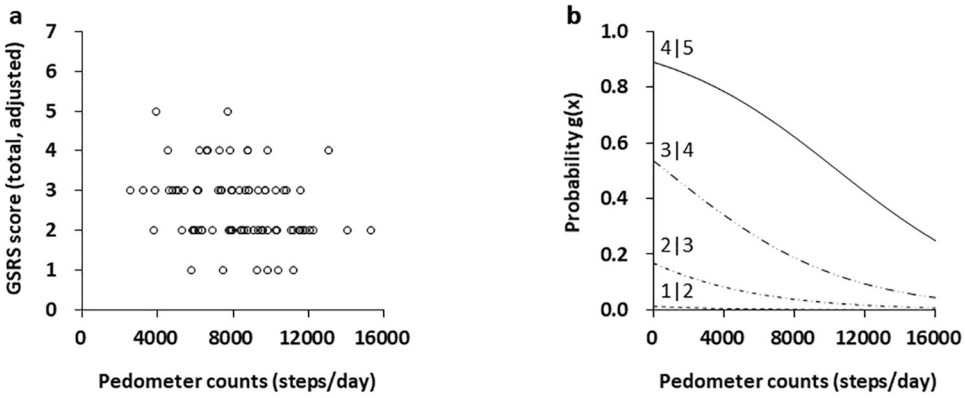

Fig 3. Logistic probability plots of the relationship between GSRS score and pedometer counts in female participants. (A) Scatterplots of Gastrointestinal Symptoms Rating Scale (GSRS) score and daily pedometer counts in female participants with irritable bowel syndrome (IBS) (n = 78). (B) Logistic curves separated by GSRS scores of 5 (moderately severe discomfort) and 2 (broken line: minor discomfort), GSRS scores of 5 and 4 (solid line), and GSRS scores of 4 and 3 (chain line) were in a stepwise fit. Ordinal logistic regression model, z = -2.44, stepwise fit $p = 0.01$.

https://doi.org/10.1371/journal.pone.0234089.g003

Discussion

This study investigated the relationship between the number of daily step counts and GI symptoms by applying an ordinal logistic model to data collected from younger people with IBS. Our results indicated that locomotor activity and GI symptoms were correlated, and threshold levels of locomotor activity that could predict GI symptoms in IBS exist. We have also observed independent probabilities for IBS symptoms in relation to locomotor activity. Our findings suggest gender difference in the symptoms and its effects, which was predictable considering the female predominance of our cohort. On the ordinal logistic regression analysis data from the female participants were comparable to the overall results of the analysis, while the data from the male participants were not. Therefore, the results of this study can also serve as reference values for young female patients with IBS.

To the best of our knowledge, using a model formula to predict GI symptoms of IBS based on daily step counts is a novel method in this field. Therefore, we estimated the degree of attenuation of GI symptoms of IBS in our participants, especially in young females, by applying this formula to the recommended daily momentum in Healthy Japan 21 [10]. For example, probability for daily locomotor activity to discriminate between GSRS scores 5 and 4 was 60% probability for 8500 steps per day in reference to the recommended daily step counts for a healthy female according to the Health Japan 21. This result indicates that the equivalent number of steps recommended by Healthy Japan 21 may also be an effective target for patients with IBS.

Physical activity using a pedometer-based guideline could increase public health outcomes, [23, 24] with 3000 steps in 30 min (100 steps/min) considered as moderate-intensity activity [25]. Increased physical activity may improve IBS symptoms through different mechanisms [6, 8]. Mild physical activity enhances intestinal gas clearance and reduces symptoms in patients with bloating [26, 27]. To increase colon transit time in adults with chronic constipation [28], 30 min of daily walking is recommended to improve the defecation pattern [29]. A recent study demonstrated that inflammatory biomarkers [30] were attenuated after 24 weeks of moderate-intensity aerobic exercise [31]. Thus, routine physical activity may be a useful primary treatment modality in IBS.

This study has some limitations. (1) The participants in this study had mild IBS symptoms but were not taking medication. Since IBS improves with medications [32, 33] it is necessary

to investigate whether there is a relationship between locomotor activity and digestive symptoms among patients taking medications. (2) Dietary therapy is effective in IBS [34, 35]. However, we did not investigate patients' meal contents during the study period. It is unclear whether dietary contents affect the relationship between exercise and GI symptoms in IBS. Future studies are required to investigate such correlations. (3) This study did not use an index to estimate IBS symptoms other than GSRS. It is necessary to verify the relationship and effects using IBS-QOL [36] and other indicators. (4) The present analysis targeted younger people, and no stratification analysis was performed based on age. The recommended amount of locomotor activity differs between the young and elderly individuals in Health Japan 21 [10]. Thus, it is necessary to investigate the relationship between GI symptoms and daily effects of locomotor activity and to build a prediction model for elderly people. (5) There was no significant association between GI symptoms and locomotor activity in males with IBS in this study. There were gender differences in the symptoms of IBS [37] characterized by constipation and diarrhea. The Prevalence of IBS subtypes were similar to those in a previous study [38]; no IBS subtypes were included in our analysis. In addition, symptoms vary with age [39]; therefore, future studies with larger cohorts should be stratified by age and IBS subtype to further investigate the relationship between physical activity and digestive symptoms. (6) The purpose of the study was explained to the participants during the informed consent process. Thus, participants may have increased their physical activity during the study period since they were informed that IBS symptoms are affected by the amount of physical activity. It is unclear whether the information bias was influenced by the participants' knowledge of the study aims. Therefore, the effect of the bias should be verified by a study examining the effects of information on the relationship between GI symptoms and physical activity among people with IBS. (7) This study used Rome III criteria, when the study was planned in 2015. The IBS diagnostic criteria were updated to ROME IV [40, 41], and the Japanese version of the questionnaire has not yet been published. In Rome IV, the evaluation of the symptoms has changed from that of Rome III, including the emphasis on the subjective experience of abdominal pain in IBS patients, and the demarcation between the constipation subtype of IBS and functional constipation. In subsequent studies, IBS diagnostic criteria should be based on ROME IV.

Based on our findings, increasing the daily step count to 9500 steps from 4000 steps will result in 50% reduction in the severity of symptoms. Previous studies have shown that exercise improves IBS symptoms [7, 11]. Current data has suggested the "degree" (amount) of physical activity required to attenuate IBS symptoms. The results of this study can provide the clinicians with information on how many steps to add to the current physical activity level among IBS patients that can reduce GSRS by 1 point. However, the effect of exercise on symptom improvement in IBS patients with mild to moderate discomfort is considered small. The effects of locomotor activity in decreasing GSRS scores should be determined in an intervention study in the future. It is recommended that patients with IBS exercise on a daily basis; however, there is no consensus on the type of exercise to be performed. In conclusion, the results of this study demonstrated that the amount of locomotor activity was related to GI symptoms in younger people with IBS by applying an ordinal logistic model. Furthermore, the results suggest that the amount of daily locomotor activity may attenuate IBS symptoms among younger people, especially female IBS patients. These results may be used as a measure to determine the daily step counts for reducing the severity of GI symptoms in individuals with IBS.

Supporting information

S1 Table. Target values for daily step counts in younger people with IBS. Estimated probability rate for Gastrointestinal Symptoms Rating Scale (GSRS) score by ordinal logistic

modeling in all participants in this study (n = 101). The Health Japan 21 recommended a daily activity level of 8500 steps/day for females and 9000 steps/day for males. IBS, irritable bowel syndrome.
(DOCX)

S2 Table. Target values for daily step counts in younger females with IBS. Estimated probability rate for Gastrointestinal Symptoms Rating Scale (GSRS) score by ordinal logistic modeling. The Health Japan 21 recommended a daily activity level of 8500 steps/day for females. If a female patient with IBS walked only 4000 steps/day, she will attain GSRS score 5 with probability of 78.5%, while 8500 steps/day will reduce the probability to 59.7%. IBS, irritable bowel syndrome.
(DOCX)

S1 Dataset.
(XLSX)

Acknowledgments

The authors would like to thank all the staff of the department of Regional Industry-Academia Collaboration, Saitama Prefectural University (Koichi Suda, Akiko Yanagisawa, Keiko Hatano, Shigemi Wakisaka, Mina Takeuchi, Miho Kitada and, Masami Shirota) for their contributions and the operational approval to conduct this study.

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Formal analysis: Toyohiro Hamaguchi, Makoto Suzuki, Hirokazu Takizawa, Kohei Koizumi, Yoshifumi Amano.

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Project administration: Toyohiro Hamaguchi.

Resources: Hirokazu Takizawa, Yoshifumi Amano.

Software: Makoto Suzuki.

Supervision: Naoki Nakaya, Motoyori Kanazawa, Shin Fukudo.

Validation: Makoto Suzuki, Motoyori Kanazawa, Shin Fukudo.

Visualization: Toyohiro Hamaguchi, Makoto Suzuki.

Writing – original draft: Toyohiro Hamaguchi, Makoto Suzuki.

Writing – review & editing: Naoki Nakaya, Motoyori Kanazawa, Shin Fukudo.

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Journal of Bodywork & Movement Therapies 23 (2019) 161–165

Contents lists available at ScienceDirect

Journal of Bodywork & Movement Therapies

journal homepage: www.elsevier.com/jbmt

PREVENTION AND REHABILITATION: PILOT STUDY

The effect of aerobic exercises among women with mild and moderate irritable bowel syndrome: A pilot study

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ARTICLE INFO

Article history:
Received 25 April 2017
Received in revised form
19 January 2018
Accepted 30 January 2018

Keywords:
Aerobic exercises
Treadmill
Irritable bowel syndrome
Severity of the symptoms
Quality of life

ABSTRACT

Background: Irritable Bowel Syndrome (IBS) is a functional bowel disorder characterized by abdominal pain or discomfort. Although patients with IBS are commonly recommended to increase their physical activity, after reviewing the literature, it was found that no study has assessed the effect of aerobic exercises on the severity of symptoms and quality of life in patients with IBS. Therefore the aim of the present study was to evaluate the effect of aerobic exercises with treadmill on the severity of symptoms and quality of life among women with mild and moderate IBS.
Methods: Twenty women with mild and moderate IBS were randomly assigned into two groups of treadmill exercise (10 participants) and control (10 participants). The treadmill group had six weeks (30 min, three sessions per week) of aerobic exercises on treadmill. The control group continued their usual daily activities.
Results: After six weeks of aerobic exercises on a treadmill a significant improvement was observed in the severity of IBS symptoms ($p \leq 0.001$) and IBS quality of life ($p = 0.001$) in the treadmill group compared to the control group. Also in the treadmill group, the severity of symptoms and quality of life demonstrated a significant improvement after the intervention compared to before the intervention ($p \leq 0.001$). No significant difference was observed in the severity of symptoms and quality of life in the control group before and after the study ($p > 0.05$).

1. Introduction

Irritable Bowel Syndrome (IBS) is a functional bowel disorder characterized by abdominal pain or discomfort. IBS is associated with alteration in bowel habits like diarrhea or constipation which have no structural, biochemical or metabolic sources (Keshteli et al., 2015a,b). The symptoms of IBS could be caused by increased visceral sensitivity, bowel movement disorder, and genetic, environmental and psychological factors (Brandt et al., 2009). The prevalence of IBS in Iran is 24% among women and 18.3% among men (Keshteli et al., 2015a,b). There is no relation between the prevalence of IBS and age and educational level. Women suffer from IBS 1.5 times more than men and it is more common among people with lower social and economic condition (Brandt et al., 2009). IBS is one of the most common cause of referring to gastroenterologists (Nellesen et al., 2013). High prevalence of IBS has a significant impact on healthcare costs (Leong et al., 2003). IBS may significantly decrease the quality of life in patients but does not automatically lead to any serious conditions or death (El-Salhy and Gundersen, 2015).

The most significant symptoms of IBS are chronic or recurrent abdominal pain or discomfort associated with diarrhea, constipation or bloating (El-Serag, 2002). The symptoms of IBS vary in intensity over time (Mearin et al., 2004). Patients with IBS have a higher prevalence of migraine, fibromyalgia and depression. (Cole et al., 2006). In Iran about half of the patients with IBS also experience anxiety or depression that is more common in patients in whom IBS constipation is dominant (Farzaneh et al., 2013). It is believed that psychological stress may lead to dysfunction of the autonomic nervous system and gastrointestinal disturbances involving gut-hormone (gastrin, glucagon and motilin) so affecting bowel movements (Fukudo and Suzuki, 1987).

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https://doi.org/10.1016/j.jbmt.2018.02.003
1360-8592/

Nowadays ROME III criteria are used for the diagnosis of IBS. IBS is diagnosed after eliminating the possibility of other organic diseases. If accurate medical history and full examination is provided (Locke et al., 2002; Longstreth et al., 2006; Spiller et al., 2007) and the patient exhibits no symptoms of rectal bleeding, anemia, fever, history of colon cancer in the family, weight loss, being over 50 years old and extreme changes in the symptoms (Longstreth et al., 2006), IBS may be diagnosed with no further tests. According to ROME III criteria (Uran et al., 2014), IBS is a disorder which its symptoms have started three months prior to the diagnosis. These symptoms are characterized as recurrent abdominal pain or discomfort which has lasted for at least three days per month during the past three months and is associated with two or more of the following items:

Pain decreases or disappears completely after defecation, onset of pain is associated with changes in the frequency of stool and onset of the pain is associated with changes in the appearance of the stool (Uran et al., 2014).

Based on ROME III classification, IBS patients are categorized into four groups: patients with constipation-predominant IBS, patients with diarrhea-predominant IBS, patients with a combination of constipation and diarrhea and finally, patients who could be categorized in any of these groups (Longstreth et al., 2006). The clinical severity of IBS symptoms are categorized into mild (40%), moderate (35%) and severe (25%) groups (Drossman et al., 2011). Mild, moderate and severe cases of IBS are respectively presented by a score of 75–175, 175 to 300 and more than 300 from the IBS severity scoring system (IBS-SSS) questionnaire (Masaeli et al., 2013).

Appropriate suggested treatments for IBS include laxatives for constipation, antimotility drugs for diarrhea, dietary changes, drinking fluids, psychological management and antidepressants for mood changes (Leong et al., 2003).

A number of studies have proven the role of increased physical activity on the symptoms of IBS patients. They have shown that increased physical activity improves quality of life and decreases severity of the symptoms, fatigue, anxiety, depression, abdominal pain and the number of visits to the physician and dieticians (Bengtsson et al., 2006; Johannesson et al., 2010; Jafari and Rahmanian, 2013; Johannesson et al., 2015; Nunan et al., 2015). Johanneson et al in 2010 classified IBS patients to a physical activity group and a control group. The physical activity group was instructed by a physiotherapist to increase their physical activity according to individual factors such as time and costs. The control group was instructed to maintain their lifestyle. Johanneson et al. showed that increased physical activity improves gastrointestinal symptoms and quality of life in IBS patients (Johannesson et al., 2010). The 5 years follow up study showed that increased physical activity had positive long term effects on gastrointestinal symptoms, quality of life, fatigue, depression and anxiety (Johannesson et al., 2015). In another study Jafari and Rahmanian in 2010 evaluated the effects of aerobic exercises on reducing dysphoric mood in patients with IBS. IBS patients did aerobic exercises 3 sessions per week for 9 weeks. At the end of 9 weeks anxiety and depression of IBS patients significantly decreased (Jafari and Rahmanian, 2013). Bengtsson, Ulander et al in 2006 evaluated the effects of a course of instruction on IBS. IBS patient were participated in a programme of instruction on medical care, physical activity, diet, stress management and health insurance. 12 months after the course, there were improvement in abdominal pain, vitality and reduction in the number of visits to physicians and dieticians (Bengtsson et al., 2006).

Literature review revealed that no study has assessed the effect of aerobic exercises with a specific therapeutic protocol on the IBS quality of life and severity of IBS symptoms. Considering the high prevalence of IBS in Iran (Keshteli et al., 2015a,b), and also noting that physical activity has been suggested as the primary modality treatment for IBS (Johannesson et al., 2010), the aim of the present study was to evaluate the effect of aerobic exercises with treadmill on the severity of the symptoms and quality of life among women with mild and moderate IBS.

2. Methods

The present study was a controlled clinical trial which evaluated the effect of aerobic exercises with treadmill on the severity of symptoms and quality of life among women with mild and moderate IBS; results were compared with the results of other women with mild and moderate IBS who only performed their usual daily activities during the same period of the time. The study was performed at the musculoskeletal disorders research center of the rehabilitation faculty of Isfahan University of Medical Sciences. Before data gathering, the study was approved by the ethics committee of the Isfahan University of Medical Sciences. The studied participants were informed about the research nature of the treatment. Then patients who were willing to participate in the study were asked to sign a written informed consent form. All of the personal characteristics of the patients were confidentially recorded for data analysis. Since no similar studies were found, a pilot study with 10 participants in each group was conducted. Considering the higher prevalence of IBS among women than men (Keshteli et al., 2015a,b), and to eliminate the effect of gender, 20 female IBS patients based on the ROME III criteria were enrolled in the study.

Patients were referred to the center by gastroenterologists from across the city. Patients completed IBS-SSS questionnaire for assessing their eligibility for the study. IBS-SSS questionnaire contains five questions which would measure pain severity, pain frequency, abdominal bloating, bowel habit dissatisfaction, and life interference using Visual Analogue Scale (VAS). The mean score of each item ranges from 0 to 100 and the total mean score of the questionnaire ranges from 0 to 500; higher scores indicates more severe symptoms (Bijkerk et al., 2003). The goal and the method of the study were explained for the participants. All of the participants were selected according to the mentioned criteria in Table 1. Place Table 1 here.

Participants were selected through non-randomized simple sampling and were randomly (shaking a dice) assigned into two groups of intervention and control. Patients with odd numbers were allocated to one group and those with even numbers were allocated into the other group. The severity of symptoms and quality of life in both groups were evaluated before the study by IBS-SSS and IBS quality of life (IBS-QOL) questionnaires. Persian version of IBS-SSS and IBS-QOL questionnaires are valid and reliable (Gholamrezaei et al., 2009; Gholamrezaei et al., 2011). Both groups were asked to continue their usual daily activities just like before the study. None of the IBS patients in the treadmill and control groups regularly exercised before the start of study. To perform aerobic exercises, a Turbo 100 treadmill device made in Taiwan was used. The intervention group performed the treadmill exercises three times a week for six weeks (McArdle et al., 2010) based on the following protocol:

First, the target and maximum heart rate were calculated with the formula (target heart rate = 70% maximum heart rate, maximum heart rate = 220−age). The treadmill used was able to record heart rate. The patient's heart rate was recorded by placing her hands on treadmill handles. Then the participants walked on the treadmill with a slow speed for 5 min to warm-up. After that, they increased their speed until they reached the target heart rate and maintained it for 20 min finally, they walked on the treadmill

Table 1
The inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Females with mild and moderate IBS (Drossman et al., 2011). Being able to increase the level of physical activity (Johannesson et al., 2010). Being aged from 18 to 65 years old (Johannesson et al., 2010). Having baseline stable blood pressure (Salacinski et al., 2012).	Doing aerobic exercises (Johannesson et al., 2010). Having a history of rheumatic diseases in lower limb (Thorp et al., 2006; Chang et al., 2007; Debi et al., 2009; Bechard et al., 2012). Having a history of metabolic diseases, neurologic disorders, cardiovascular problems, and respiratory, renal and lung problems which would prevent them from participating in aerobic exercises (Kovar et al., 1992; Ettinger et al., 1997; Mangione et al., 1999; Jafari and Rahmanian, 2013). Having a history of knee injury or knee surgery during the past year (Debi et al., 2009). Having a history of joint replacement in any of the joints of the lower limb (Thorp et al., 2006; Chang et al., 2007; Zeni and Higginson, 2009). Having a history of fracture in the lower limb during the past six months (Thorp et al., 2006). Having clinical symptoms of osteoarthritis in the joints of hip, knee, ankle and foot (Thorp et al., 2006). Major vision disorders (McGibbon et al., 2003; Kim et al., 2011). Hereditary or acquired musculoskeletal disorders in lower limb (Hunt et al., 2010). Organic gastrointestinal disorders (Johannesson et al., 2010). Using drugs that would affect metabolism or balance (Sweetman Sean, 2009). Using assistive devices for walking (Ettinger et al., 1997). Pregnancy (Johannesson et al., 2010).

for 5 min with a slow speed to cool-down (Kisner and Colby, 2012). Treadmill exercise was done with supervision of physiotherapist in all sessions.

In case of patient's desire to stop the exercise, lightheadedness, confusion, cyanosis, pallor and nausea, the exercise program was stopped (Kisner and Colby, 2012). None of the IBS patients in the treadmill and control groups desired to stop exercise. At the end of the final session, the severity of symptoms and quality of life in both groups were measured again using the IBS-SSS and IBS-QOL questionnaires.

3. Results

Demographic characteristics of the participants of the control and treadmill groups are presented in Table 2. All of the data were analyzed using SPSS20 with a significant level of 0.05. Based on the results of Shapirowilk test, variables' distribution was normal. Therefore, to evaluate the severity of symptoms and quality of life, independent *t*-test and paired *t*-test were used.

Studied groups had no significant difference regarding their demographic characteristics including age, educational level, marital status and severity of symptoms ($p > 0.05$). Studied groups had no significant difference in quality of life and severity of symptoms before the study. Place Table 2 here.

Results of independent *t*-test and paired *t*-test for the control and treadmill groups are shown in Table 3. Intra group comparison showed a significant difference between the scores of severity of symptoms and quality of life before and after the intervention in the treadmill group ($p \leq 0.001$) (increasing in quality of life and decreasing in severity of the symptoms). No significant difference was observed between the scores of severity of symptoms and quality of life in the control group before and after the study (intra-group comparison) ($p > 0.05$). Comparing both groups showed that, after completing the therapeutic program, the severity of symptoms had a significant difference between the treadmill and the control group ($p \leq 0.001$) (decreasing in the severity of symptoms). Also the quality of life in the treadmill group had a significant difference with the control group after the intervention ($p = 0.001$) (increasing in the quality of life). Place Table 3 here.

4. Discussion

Based on the conducted literature review, it seems this is the first study evaluated the effect of aerobic exercises with treadmill on the severity of symptoms and quality of life in women with mild and moderate IBS, and compared these results with a control group who only has performed their usual daily activities.

Johannesson et al in 2010 evaluated the effect of physical activity on the severity of symptoms and quality of life among women with IBS. In this study, participants of the control group were asked to continue their usual daily activities for 12 weeks while participants of the intervention group were recommended to increase the level of their physical activity. The researchers showed that increased the level of physical activity may improve the severity of symptoms and quality of life in IBS patients and the severity of symptoms may increase in patients who are physically inactive. Johannesson et al. presented physical activity as the primary treatment modality for IBS patients (Johannesson et al., 2010). In the mentioned study, a specific controlled protocol with determined intensity and frequency did not exist. Results of the present study showed that six weeks of aerobic exercising with treadmill may increase the quality of life and decrease the severity of symptoms in women with mild and moderate IBS, compared to before the intervention. While no significant difference was

Table 2
Demographic characteristics of the treadmill and the control groups.

Variables		Control group	Treadmill group	P value
Age		32.70 ± 10.27 (mean ± SD)	29/10 ± 6.80 (mean ± SD)	0.0386
Educational level	Diploma	4 (40%)	2 (20%)	0.515
	Associate's degree	2 (20%)	1 (10%)	
	Bachelor's degree	2 (20%)	5 (50%)	
	Master's degree	2 (20%)	2 (20%)	
Marital status	Single	4 (40%)	5 (50%)	0.653
	Married	6 (60%)	5 (50%)	
Severity of symptoms	Mild	4 (40%)	4 (40%)	>0.99
	Moderate	6 (60%)	6 (60%)	

Table 3
Comparing the quality of life and the severity of symptoms before and after the intervention between the control and the treadmill groups.

Groups		Quality of life (mean ± SD)	Severity of symptoms (mean ± SD)
Treadmill	Before the intervention	64.03 ± 21.59	203.96 ± 65.69
	After the intervention	89.99 ± 8.53	69.60 ± 51.04
	Paired differences	25.96 ± 14.23	−134.35 ± 45.89
	P value[a]	≤0.001	≤0.001
Control	Before the intervention	70.93 ± 19.72	182.19 ± 78.20
	After the intervention	57.85 ± 16.06	212.82 ± 79.81
	Paired differences	- 13.08 ± 26.14	30.63 ± 55.81
	P value[a]	0.148	0.117
	P value[b] (before the study)	0.465	0.509
	P value[b] (after the study)	0.001	≤0.001

[a] Resulted from paired *t*-test.
[b] Resulted from independent *t*-test based on the mean of differences.

observed between the scores of quality of life and the severity of symptoms of the control group before and after the study. The decrease in the severity of symptoms and the increase in the quality of life in the group who exercised with treadmill and also lack of improvement in the severity of symptoms and quality of life in the group who continued their usual daily activities may indicate that the prescribed program had a desirable effect on the severity of symptoms and quality of life in IBS patients. Therefore, results of the present study were consistent with the results of Johannesson et al. (Johannesson et al., 2010).

In another study, Levy et al in 2005 evaluated the gastrointestinal symptoms of obese patients in a weight loss program and presented the relation of gastrointestinal symptoms with obesity, diet (consumption of fat, fruit and fiber) and physical activity. The participants completed questionnaires about their physical activity, diet and gastrointestinal symptoms at the beginning of and 24 months after the intervention. In this study Levy et al. showed that obesity had a direct relation with abdominal pain and diarrhea. While healthier diet (consuming less fat and more fruit and fiber) and more physical activity may decrease gastrointestinal symptoms (Levy et al., 2005). Decrease in the severity of symptoms in the treadmill group of the present study would support the results of Levy et al.

The participants of both groups in the present study had no significant difference in their demographic characteristics including age, educational level, marital status and the severity of symptoms before the study. Therefore, it could be concluded that all of the occurred differences between the two groups were due to the effects of the applied protocol.

Several mechanisms may contribute to improve the severity of symptoms and quality of life of the treadmill group in the present study. Probably physical and psychological factors are effective. The role of the physical factors may be that due to the increased level of physical activity, gas transit and bowel movements would increase which could be related to the improvement in severity of IBS symptoms (Johannesson et al., 2015). Dainese et al in 2004 showed that moderate physical activity decreases gas transit time and reduces abdominal distension in healthy subjects (Dainese et al., 2004). Also the brain-gut interaction, as the psychological factor, may be effective in the results of the present study; meaning that, stress induces exaggeration of the neuroendocrine response and visceral perceptual, (Posserud et al., 2004), while physical activity counteracts the effects of stress (Dishman et al., 2006). Physical activity, by facilitating the processes of neurogeneratives, neuroadaptives and neuroprotectives of the central nerve system, may have a positive effect on brain-gut axis, which is involved in IBS (Dishman et al., 2006). On the other hand, increased cardiorespiratory fitness and physical activity is associated with less depressive symptoms and greater emotional well-being (Galper et al., 2006). It is speculated that physical activity decreases visceral blood flow, increases gastrointestinal motility, enhances immune function and compression of the gut (Peters et al., 2001). Also, some studies have shown that physical activity decreases colonic transit time and incomplete defecations in patients suffering from chronic constipation (De Schryver et al. 2005), which is a common symptom of IBS (Nunan et al., 2015). Therefore, the results of the present study which showed an improvement in the quality of life and the severity of symptoms in IBS patients after aerobic exercises seem rational.

4.1. Limitations

The potential limitation of the present study was the small sample size and lack of follow-up period to evaluate the effects of aerobic exercises in IBS patients. Another limitation was that only women were included in this study.

4.2. Suggestions

In the future it is recommended to perform further studies with larger sample sizes and follow-up period to evaluate the effects of aerobic exercises in IBS patients.

5. Conclusions

According to the results of the present study, it could be concluded that six weeks of walking on treadmill may significantly decrease the severity of symptoms and improve the quality of life among women with mild and moderate IBS; however, how long term the effects would be, if exercise were to be discontinued, remains unclear.

Conflicts of interest

The authors have no conflict of interests regarding this paper.

Acknowledgements

This article was adapted from a master's thesis which was funded by the Isfahan University of Medical Sciences (395528). The authors would like to thank all of the participants for their cooperation.

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RESEARCH ARTICLE

Physical activity in relation to irritable bowel syndrome among Iranian adults

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OPEN ACCESS

Citation: Sadeghian M, Sadeghi O, Hassanzadeh Keshteli A, Daghaghzadeh H, Esmaillzadeh A, Adibi P (2018) Physical activity in relation to irritable bowel syndrome among Iranian adults. PLoS ONE 13(10): e0205806. https://doi.org/10.1371/journal.pone.0205806

Editor: Hassan Ashktorab, Howard University, UNITED STATES

Received: December 26, 2017

Accepted: October 2, 2018

Published: October 18, 2018

Data Availability Statement: Because of ethical restrictions on sharing a de-identified data set (data contain potentially identifying or sensitive patient information), data from this study are available upon request. These restrictions were imposed by the Ethics Committee and principle investigator. Data access requests should be sent to the Deputy for Research at Isfahan University of Medical Sciences (research@mui.ac.ir; http://research.mui.ac.ir).

Abstract

Background

Irritable bowel syndrome (IBS) is the most prevalent functional gastrointestinal disorder worldwide. Physical activity in relation to IBS has been investigated in few studies and data in this regard are conflicting.

Aim

To investigate the association between physical activity and IBS in a large sample of Iranian adults.

Methods

This cross-sectional study was done on 4763 Iranian adults in the framework of SEPAHAN (The Study on the Epidemiology of Psycho-Alimentary Health and Nutrition) project. The physical activity of study participants was assessed using the General Practice Physical Activity Questionnaire (GPPAQ). Using a validated self-administered modified Rome III questionnaire, functional gastrointestinal disorders including irritable bowel syndrome was assessed.

Results

The mean age of study participants was 36.5 years. Irritable bowel syndrome was prevalent among 21.5% of participants. Compared with physically active individuals (≥ 1 hour/wk), those with sedentary physical activity (<1 hour/wk) had 1.27 times greater probability of suffering from IBS (OR: 1.27, 95% CI: 1.08–1.49). However, this association was attenuated after adjusting for age, sex, cigarette smoking and medical history of colitis and diabetes. When the analysis was additionally adjusted for diet-related practices and body mass index

Funding: The study was provided funding by Isfahan University of Medical Sciences, Isfahan, Iran (www.mui.ac.ir) (projects numbers #189069 to PA, #189082 to AE, and #189086 to AE). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing interests: The authors have declared that no competing interests exist.

(BMI), a non-significant association was found between sedentary physical activity and IBS (OR: 1.18, 95% CI: 0.98–1.41). Gender-stratified analysis revealed similar findings in women either before (OR: 1.29, 95% CI: 1.04–1.61) or after controlling for covariates (OR: 1.27, 95% CI: 0.99–1.62). In BMI-stratified analysis, a significant positive association was seen between sedentary physical activity and IBS among individuals with normal BMI (OR: 1.38, 95% CI: 1.07–1.79).

Conclusion

We found a significant positive association between sedentary physical activity and IBS, particularly among women and individuals of normal weight.

Introduction

Irritable bowel syndrome (IBS) is a chronic condition characterized by recurrent abdominal pain or discomfort associated with disturbances in defecation, stool frequency or stool form [1]. Different diagnostic criteria used in earlier studies have resulted in various ranges of prevalence of this syndrome [2]. It is highly prevalent globally and varies from 5–10% in Asia to 9–22% in the European countries [3–5]. In Iran, its prevalence has been estimated to vary from 1.1% to 25% in various studies [6]. Patients suffering from IBS have unfavorable quality of life and considerable costs induced due to subsequent medical care [7].

Several factors, including environmental factors, contribute to IBS etiology [8]. Physical activity is of benefit for health; however, limited data with conflicting results are available linking physical activity to IBS. Previous studies have reported that spending more time doing moderate physical activity is associated with improved symptoms of IBS [9]. In healthy individuals, physical activity has been associated with improvement in gas transit and abdominal distension, symptoms that are frequently observed in IBS patients [10]. Other medical conditions including depression and fibromyalgia, which accompany with IBS, were suggested to undergo reduction with regular mild exercise [11]. Other reports have also documented the beneficial role of physical activity in IBS management [12–13]. Findings from case-control studies have revealed lower physical activity levels in patients with IBS [14, 15]. However, some investigators have failed to find a significant association between physical activity and IBS. Omagari et al [8] reported a high level of physical activity among patients with IBS than those without IBS. Overall, it seems that further studies are required to shed light on this association. It must be kept in mind that almost all earlier studies have been confined to IBS symptoms rather than its prevalence as a functional gastrointestinal disorder and we are aware of no epidemiologic study investigating the association between physical activity and IBS [11–13, 16, 17]. In addition, previous observational studies were conducted among a group of IBS patients and no population-based study is available in this regard. Furthermore, almost all prior investigations were performed on a small sample size and those with relatively large samples have been confined to children. Moreover, all earlier studies were conducted in Western countries and, to the best of our knowledge, no such report is available from Middle-Eastern countries. Considering the cultural differences between the Middle-Eastern and Western populations, the association between physical activity and IBS might be different in this part of the world. In the current study, we aimed to investigate the association of physical activity with IBS in the framework of a large population-based study in Iran.

Subjects and methods

Participants

We used data from SEPAHAN (The Study on the Epidemiology of Psycho-Alimentary Health and Nutrition) project to conduct this cross-sectional study. This project, which was conducted in 2010, investigated the epidemiological aspects of functional gastrointestinal disorders and their relationships with different lifestyle factors. Study design, sampling methods, participant characteristics and data collection procedures have been previously published in detail [18]. Staff from Isfahan University of Medical Sciences (IUMS) working in 50 different centers (health centers, hospitals, administrative sections) were included in the current study. Data was collected in two separate phases. In the first phase, 10087 adults were asked to complete self-administered questionnaires on lifestyle factors, including physical activity with 8691 subjects returning the completed questionnaire (response rate: 86.2%). In the second phase, 9652 questionnaires containing information on gastrointestinal symptoms were sent to the participants and 6239 completed questionnaires were returned (response rate: 64.6%). When we combined data from both phases, information was available for 4763 subjects who had completed both questionnaires. All data was fully anonymized before the researcher had access. Signed written consent forms were provided by all participants. The study was approved by Isfahan University of Medical Sciences, Isfahan, Iran (www.mui.ac.ir) (projects numbers #189069, #189082, and #189086).

Assessment of physical activity

The physical activity levels of study participants were assessed using the General Practice Physical Activity Questionnaire (GPPAQ). This questionnaire is a simple tool ranking participants' physical activity with focus on their current general activities. GPPAQ is a validated short measure of physical activity that was accredited by the Department of Health and developed by the London School of Hygiene and Tropical Medicine [19]. Patients were requested to report their activities based on GPPAQ, which took approximately 30 seconds to fill. Current physical activity has been used as a reliable contributor for objective assessment of overall physical activity levels. Based on their responses, participants were classified into 4 categories; 1) Inactive (sedentary job and no physical exercise or cycling), 2) Moderately inactive (sedentary job and some but $<$1 hour physical exercise and/or cycling per week OR standing job and no physical exercise or cycling), 3) Moderately active (sedentary job and 1–2.9 hours physical exercise and/or cycling per week OR standing job and some but $<$1 hour physical exercise and/or cycling per week OR physical job and no physical exercise or cycling), 4) Active (sedentary job and $>$ 3 hours physical exercise and/or cycling per week OR standing job and 1–2.9 hours physical exercise and/or cycling per week OR physical job and some but $<$ 1 hour physical exercise and/or cycling per week OR heavy manual job). However, in the current study due to low number of subjects in some of the above-mentioned categories, individuals in the "inactive" and "moderately inactive" groups were combined and were defined as those with "sedentary physical activity". Similarly, individuals in the "moderately active" and "active" categories were combined and then defined as "physically active".

Assessment of irritable bowel syndrome

Using a validated self-administered modified Rome III questionnaire, different gastrointestinal disorders including symptoms related to IBS were assessed [1]. Since during the face validity evaluation of our study, we found that most participants found it difficult to discriminate the descriptors used in the original Rome III (never, less than one day a month, one day a month,

two to three days a month, one day a week, more than one day a week, every day), we modified the rating scale into 4 descriptors (i.e. never or rarely, sometimes, often, always). We also asked whether each symptom was present in the past three months. In the current study, on the basis of the Rome III diagnostic criteria for functional gastrointestinal disorders, we defined IBS as having recurrent abdominal pain or discomfort at least "sometime" in the last 3 months associated with two or more of these criteria: improvement with defecation at least "sometimes" and onset associated with change in frequency or form (appearance) of stool at least "sometimes". The Persian version of the Rome III questionnaire for Iranian population was validated previously [20].

Assessment of other variables

Information on age, gender, weight, height, smoking status (non-smokers, ex-smokers and current smokers) and educational status were collected using a self-reported questionnaire. Furthermore, a questionnaire was used to gather data on medical history (diabetes and colitis) and medications used for IBS treatment. Participants were questioned regarding meal regularity (never/sometimes/often/always), chewing sufficiency (a lot/moderately/little), eating rate ($<$10 min/$\geq$10 min), intra-meal fluid consumption (never/sometimes/often/always) as well as the frequency of breakfast consumption (never or 1 day per week/2–4 days per week/5–6 days per week and every day), spicy food intake (never, 1–3 times/wk, 4–6 times/wk or more than 10 times), quantity of consumed spices (low, moderate, high), and fried food consumption (never, 1–3 times/wk, 4–6 times/wk or every day). In terms of dental status, participants were classified into 3 categories; "fully dentate", "loss of 1–5 teeth" and "loss of more than 5 teeth".

Statistical analysis

All statistical analyses were done in SPSS (version 18). We applied independent samples t-test to examine significant differences between participants with sedentary physical activity and physically active in terms of continuous variables. Distribution of participants with regards to categorical variables was evaluated using Chi-square test. To examine the odds of IBS among categories of physical activity, we used binary logistic regression in crude and adjusted models. In the first model, age (continuous) and gender (categorical) were adjusted for. Further controlling was done for cigarette smoking and medical history (colitis, diabetes) in the second model. Additional adjustment was done for regular meal pattern (never/sometimes/often/always), eating rate ($<$10 min/$\geq$10 min), chewing sufficiency (a lot/moderately/little), breakfast consumption (never or 1 day per week/2–4 days per week/5–6 days per week and every day), intra-meal fluid consumption (never/sometimes/often/always), fried food intake (never/1–3 times per week/4–6 times per week or every day), tooth status (have all teeth/lost 1–5 teeth/lost $>$5 teeth) and spicy food intake (never, 1–3 times/wk, 4–6 times/wk or more than 10 times) in the third model. In the final model, body mass index (BMI) (continuous) was additionally adjusted for to see if the association between physical activity and IBS was independent of obesity. In all mentioned analyses, physically active participants were considered as reference. The analysis, with the same covariates as mentioned above, was also done separately by gender and categories of BMI ($<$25/$\geq$25 kg/m^2). In all statistical analyses, P values of less than 0.05 were considered as significant.

Results

The mean age of study participants was 36.5±8.0 years. IBS was prevalent among 21.5% (n = 1024) of participants. General characteristics of study participants by categories of physical activity are described in **Table 1**. Compared with physically active individuals, those with sedentary physical

Table 1. General characteristics of study participants by categories of physical activity.

	physically active[1]	sedentary physical activity[2]	P-value
Age (y)	36.8 ± 8.32	36.0 ± 7.78	0.01
Weight (kg)	70.6 ± 12.71	67.8 ± 12.58	<0.001
BMI (kg/m^2)	24.8 ± 3.66	24.9 ± 3.95	0.50
Male (%)	56.5	36.5	<0.001
Current smokers (%)	13.2	13.5	0.09
Diabetes (%)	1.6	1.8	
Colitis (%)	1.0	1.2	
Regular meal pattern[3] (%)	62.9	58.1	0.01
Chewing sufficiency (a lot) (%)	16.8	12	<0.001
Fluid consumption (always) (%)	22.2	25.6	0.001
Breakfast skipping[4] (%)	20.1	23.7	0.06
Frequent fried food intake[5] (%)	16.2	16.9	0.08
Tooth loss (Have all) (%)	29.6	34.4	0.07

[1] defined as individuals with ≥1 hour/week physical activity

[2]defined as individuals with <1 hour/week physical activity

[3] defined as individuals who have reported having regular meals often or always

[4] defined as individuals who were eating breakfast < 5 times/week

[5] defined as individuals who consumed fried foods ≥ 4 times/week

https://doi.org/10.1371/journal.pone.0205806.t001

activity were younger, weighed less and were less likely to be male, have regular meal pattern, chew their foods sufficiently and were more likely to consume fluids during a meal.

Multivariable-adjusted odds ratios (95% CIs) for IBS across categories of physical activity levels are provided in Table 2. Those with sedentary physical activity had 1.27 times greater probability of suffering from IBS compared with physically active individuals (OR: 1.27, 95% CI: 1.08–1.49). However, this association was attenuated after adjusting for age, sex, cigarette smoking and medical history of colitis and diabetes. When the analysis was additionally adjusted for diet-related practices and BMI, this association became non-significant (OR: 1.18, 95% CI: 0.98–1.41). We failed to find any significant association between physical activity and IBS in men. However, among women, we found a positive significant association between sedentary physical activity and odds of IBS; such that after controlling for age, sex, cigarette smoking and medical history of colitis and diabetes, women with sedentary physical activity were 29% more likely to have IBS than physically active individuals (OR: 1.29, 95% CI: 1.02–1.63). However, this relationship became non-significant after additional adjustment for diet-related practices and BMI (OR: 1.27, 95% CI: 0.99–1.62). When we did the analyses stratified by different diet-related practices, again we failed to find any significant association.

BMI-stratified analysis on the association between physical activity and IBS is shown in Table 3. Among individuals with normal weight, those with sedentary physical activity had 35% greater odds of IBS than physically active participants (OR: 1.35, 95% CI: 1.08–1.68). This association remained significant even after taking potential confounders into account (OR: 1.38, 95% CI: 1.07–1.79). Among overweight or obese individuals, no significant association was seen between physical activity and odds of IBS.

Discussion

In the current study, we found a significant inverse association between physical activity and risk of IBS; individuals with sedentary physical activity had 27% greater odds of having IBS

Table 2. Multivariable-adjusted odds ratios (95% CIs) for irritable bowel syndrome across categories of physical activity levels[1].

		Categories of physical activity	
		physically active[2]	sedentary physical activity[3]
Whole population			
	Crude	1.00	1.27 (1.08–1.49)
	Model 1	1.00	1.20 (1.01–1.43)
	Model 2	1.00	1.19 (1.01–1.42)
	Model 3	1.00	1.18 (0.98–1.41)
	Model 4	1.00	1.18 (0.98–1.41)
Men			
	Crude	1.00	1.10 (0.87–1.40)
	Model 1	1.00	1.09 (0.84–1.42)
	Model 2	1.00	1.08 (0.84–1.41)
	Model 3	1.00	1.11 (0.84–1.47)
	Model 4	1.00	1.11 (0.84–1.47)
Women			
	Crude	1.00	1.29 (1.04–1.61)
	Model 1	1.00	1.31 (1.04–1.65)
	Model 2	1.00	1.29 (1.02–1.63)
	Model 3	1.00	1.27 (0.99–1.62)
	Model 4	1.00	1.27 (0.99–1.62)

[1] Values are ORs (95% CIs).

IBS was defined as having recurrent abdominal pain or discomfort at least sometime in the last 3 months associated with two or more of these criteria: improvement with defecation at least sometimes and onset associated with change in frequency or form (appearance) of stool at least sometimes

[2] defined as individuals with ≥1 hour/week physical activity

[3] defined as individuals with <1 hour/week physical activity

Model 1: Adjusted for age, sex

Model 2: Additionally adjusted for cigarette smoking, medical history (colitis, diabetes)

Model 3: Further adjusted for regular meal pattern, eating rate, chewing sufficiency, breakfast consumption, fluid consumption during a meal, fried food intake, tooth status and spicy food intake

Model 4: Additionally adjusted for BMI

https://doi.org/10.1371/journal.pone.0205806.t002

compared with physically active individuals. However, this was not significant after controlling for diet related practices and BMI. In addition, sex-stratified analysis revealed no significant association in men and women in fully adjusted model. We also found a significant positive association between sedentary activity and IBS among individuals of normal weight when potential confounders were taken into account. Although the sample size of the study was high, the obtained effect sizes for the association between physical activity and IBS were small. To the best of our knowledge, the current study was the first to examine the association between physical activity and IBS in the Middle East.

The prevalence of IBS in the current study is in line with earlier reports from Asian countries [21, 22]; however, it is much higher than global prevalence due to the use of a modified Rome III criteria rather than a clinical assessment for identification of IBS [23]. IBS is associated with several disabilities and significant incurred costs. Among environmental factors contributing to IBS, less attention has been paid on physical activity. Based on our findings, individuals with sedentary activity have greater risk of IBS. In line with our findings, in a cross-sectional study by "Kim et. al", using a self-reported questionnaire applied with a large

Table 3. Multivariable-adjusted odds ratios (95% CIs) for irritable bowel syndrome across categories of physical activity levels stratified by BMI status[1].

		Categories of physical activity	
		physically active[2]	sedentary physical activity[3]
BMI<25			
	Crude	1.00	1.35 (1.08–1.68)
	Age-adjusted	1.00	1.34 (1.06–1.69)
	Multivariable-adjusted[4]	1.00	1.38 (1.07–1.79)
BMI≥25			
	Crude	1.00	1.16 (0.92–1.47)
	Age-adjusted	1.00	1.17 (0.91–1.49)
	Multivariable-adjusted[4]	1.00	1.00 (0.76–1.32)

[1] Values are ORs (95% CI).

IBS was defined as having recurrent abdominal pain or discomfort at least sometime in the last 3 months associated with two or more of these criteria: improvement with defecation at least sometimes and onset associated with change in frequency or form (appearance) of stool at least sometimes

[2] defined as individuals with ≥1 hour/week physical activity

[3] defined as individuals with <1 hour/week physical activity

[4] Adjusted for age, gender, cigarette smoking, medical history (colitis, diabetes), regular meal pattern, eating rate, chewing sufficiency, breakfast consumption, fluid consumption during a meal, fried food intake, tooth status and spicy food intake

https://doi.org/10.1371/journal.pone.0205806.t003

population of university students, physical activity was inversely associated with IBS [16]." Lustyk et. al" reported that patients with IBS had spent less time on exercise compared with healthy individuals [12]. Findings from a case-control study revealed that physically active subjects were 3.6 times less likely to suffer from IBS than those with a physically inactive lifestyle [24]. Moreover, a weak trend was observed toward higher prevalence of IBS with fewer hours spent for physical activity (odds ratio: 0.99) [16]. In a clinical trial on patients with IBS, a 12-week regiment of moderate activity in the intervention group improved gastrointestinal symptoms and quality of life [13]. Altogether, it seems that promoting physical activity in the general population may help prevention of developing IBS. When we controlled for the effect of dietary habits, the association between sedentary activity and IBS became non-significant. It seems that positive association between sedentary physical activity and IBS are mediated by dietary habits or diet-related practices. For example, it has been shown that sedentary individuals consume more fluid during a meal than active ones [25]. As seen in our study, breakfast skipping, having an irregular meal pattern and chewing insufficiency were common in sedentary individuals compared with physically active ones. All mentioned diet-related practices are positively associated with IBS [25]. Therefore, this could be an explanation for the non-significant association after controlling dietary practices.

In the current study, we observed a significant positive association between sedentary physical activity and IBS among normal-weight individuals, but not among those who were overweight or obese. This difference might be explained by the effects of obesity on the regulation of gastrointestinal hormones in obese individuals compared with normal weight subjects [26]. In addition, a recent meta-analysis revealed the different effects of physical activity on secretion of Glucagon-like peptide 1 (GLP-1) in normal-weight individuals compared with those with overweight or obesity. Since GLP-1 is implicated in the pathogenesis of IBS [27], different effects of physical activity on GLP-1 may be another reason for positive association between sedentary physical activity and IBS among normal-weight individuals, but not in those with

overweight or obesity. Furthermore, a clinical trial showed that psychological stress affect less individuals with overweight or obesity than those with normal weight [28]. As reported previously, psychological stress is a risk factor for IBS.

The mechanisms behind the association between physical activity and IBS are unknown. It may be explained by the change of gas transit and colonic transit due to increased physical activity [10]. Moreover, physical activity can favorably influence brain plasticity by facilitating neurogenerative, neuroadaptive, and neuroprotective processes [29], thus have a positive effect on the brain-gut axes which is involved in IBS.

This study has several strengths. This is the first study investigating the association between IBS prevalence and physical activity in a large sample of adults. In the current study we controlled the analyses for a wide range of confounders including dietary habits which were not taken into account in earlier studies. In addition, a large sample size enabled us to conduct stratified analysis by gender and BMI categories, which was not done previously. A major weakness of this study is the cross-sectional design that limits causal inferences. In addition, the observed associations might be attributed to other factors including high intake of spicy or fatty foods [30]. Moreover, the results might not be extrapolated to the general population of Iran living in other provinces as the sampled population was a group of adults affiliated to a medical University. Although several confounders were adjusted to assess the association between physical activity and IBS, some residual confounders including psychological disorders and drug or supplements use might affect the obtained risk estimates. Furthermore, both physical activity and IBS prevalence (21.5%) were examined through the use of questionnaires in this study. However, it should be noted that the Rome III questionnaire for assessment of gastrointestinal health has been validated in the Iranian population previously and the diagnosis of IBS is criteria-based and does not require clinical assessment by a gastroenterologist in large-scale epidemiological studies. Although, the validity of GPPAQ has earlier been examined in several populations, its validity and reliability has not been tested in Iran. Therefore, misclassification of participants may be another problem in the current study. Moreover, inability to separately analyze for activity at work or leisure time is another limitation of our study. While physical activity at work appears to exacerbate gastrointestinal symptoms, leisure time activity may be a protective factor [31].

In conclusion, we found a marginally significant positive association between sedentary physical activity and IBS, particularly among women and individuals of normal weight. Further studies, particularly of prospective design, are needed to confirm our findings.

Acknowledgments

We wish to thank all participants and staff of Public Relations Unit, for the great collaboration. We also thank Dr. Melissa Silva (University of Alberta, Canada) for copyediting the manuscript.

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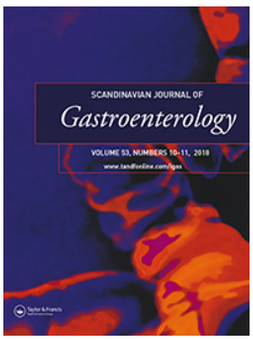

Scandinavian Journal of Gastroenterology

ISSN: 0036-5521 (Print) 1502-7708 (Online) Journal homepage: https://www.tandfonline.com/loi/igas20

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To cite this article: Elisabet Johannesson, Eva Jakobsson Ung, Riadh Sadik & Gisela Ringström (2018) Experiences of the effects of physical activity in persons with irritable bowel syndrome (IBS): a qualitative content analysis, Scandinavian Journal of Gastroenterology, 53:10-11, 1194-1200, DOI: 10.1080/00365521.2018.1519596

To link to this article: https://doi.org/10.1080/00365521.2018.1519596

Published online: 25 Nov 2018.

SCANDINAVIAN JOURNAL OF GASTROENTEROLOGY
2018, VOL. 53, NO. 10-11, 1194–1200
https://doi.org/10.1080/00365521.2018.1519596

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ORIGINAL ARTICLE

Experiences of the effects of physical activity in persons with irritable bowel syndrome (IBS): a qualitative content analysis

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ABSTRACT

Objective: Increased physical activity has been tested among patients with irritable bowel syndrome (IBS) in a randomized trial which demonstrated improvement in gastrointestinal (GI) symptoms. The patients' experiences of the effects of physical activity on IBS symptoms are unknown. This knowledge is necessary to enable suitable support from health care professionals. The aim of this study was therefore to explore patients' experiences of the effects of physical activity.

Materials and methods: Deep interviews were conducted with 15 patients (10 women and 5 men) aged 31–78 years. Their IBS had lasted for 10–57 years. The transcribed interviews were analyzed through a qualitative content analysis.

Results: The analysis of the material revealed three themes; GI symptoms, extra-intestinal symptoms, and quality of life (QOL). In relation to GI symptoms, the patients discussed how physical activity affected these symptoms and how they used physical activity to normalize and control their GI symptoms. Extra-intestinal symptoms were also affected by physical activity, and the patients described how they experienced a general bodily wellbeing as well as improved mood and energy in relation to physical activity. In terms of QOL, the patients discussed their perspectives on physical activity as giving them achievements, being pleasurable, and being strengthening of the self.

Conclusions: Our results emphasize the importance of taking into account the patient's experiences of the effects of physical activity when coaching patients with IBS to be physically active. Using a person-centred approach incorporating, the patient's own experiences and resources is the key to successfully promoting physical activity in the clinic.

ARTICLE HISTORY
Received 24 May 2018
Revised 8 August 2018
Accepted 9 August 2018

KEYWORDS
Exercise; physical activity; irritable bowel syndrome; gastrointestinal diseases; qualitative research

Background

Irritable bowel syndrome (IBS) is a common functional bowel disorder with a global prevalence of 10–15% [1]. It is characterized by abdominal pain associated with altered bowel habits, and abdominal bloating is often present [2,3]. Patients often suffer from extra-intestinal symptoms such as musculoskeletal problems, fatigue, and depression. Comorbidity is also more common among patients with IBS than among healthy controls [4,5]. Qualitative studies have explored patients' experiences of living with IBS and how they handle symptoms in their daily life [6–8]. Patients with IBS have a lower quality of life (QOL) than some patients with organic gastrointestinal (GI) disorders [9].

GI and extra-intestinal symptoms vary within the patient group, and so far there is no cure for IBS; medical treatment is directed towards the symptoms [10]. Different non-pharmacological therapies including patient education [11,12], dietary advice [13,14], and psychological therapies [15] have been evaluated in IBS. Studies have shown the importance of support from health care professionals to help patients cope with and handle the symptoms [7,16,17]. Increased physical activity has been tested among patients with IBS in a randomized trial [18] which demonstrated improvement in GI symptoms after 12 weeks of increased physical activity. However, the effects on extra-intestinal symptoms were not significant after 12 weeks and the effects on QOL were limited. It is not known how patients' experience the effects of physical activity on IBS symptoms. This knowledge is necessary to understand the patients' perspective and thereby enable suitable support and coaching from health care professionals. The aim of this study was therefore to explore patients' experiences of the effects of physical activity.

Methods

Data collection and participants

Fifteen interviews were conducted in late 2014 and early 2015. The patients who were invited by mail and a follow-up

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telephone call had previously participated in one or both of our quantitative studies on physical activity in IBS [18,19]. All patients had been diagnosed according to the Rome II criteria [20]. Exclusion criteria were organic GI diseases. Of the 75 eligible patients, 16 agreed to participate in the present study. One patient did not attend the interview.

The participating patients (10 women and 5 men) were aged 31–78 years. Twelve worked full time or part time, one was on maternity leave, and two were retired. Six had studied at university, seven had finished high school, and two had finished elementary school. Their IBS had lasted for 10–57 years. Nine had diarrhea-predominant IBS, one had constipation-predominant IBS, and five had alternating bowel habits.

All interviews were performed by the first author who had also met the participants during the quantitative studies. The participants chose the location for the interview and all interviews were conducted in open clinic health care settings apart from one which was conducted at the participant's place of work. They were unstructured, and were initiated by asking 'Can you tell me what physical activity means to you?' This starting question was followed by 'Can you tell me if there is anything strengthening or motivating in being physically active?' and 'Can you tell me if there are things hindering or stopping you from being physically active?' Probing questions were used to follow up these three questions. During the interview, the interviewer also repeated and summarized the patient's view to enhance corrections of any misunderstandings, and also encouraged the patient to exemplify and elaborate. During the interviews, the interviewer made field notes of the interviewing situation. In the timespan when the interviews were conducted the research group listened to the recordings and discussed the saturation of the data. When the last interviews were conducted the data appeared to have reached saturation. The interviews lasted for 30–80 min and were recorded and transcribed verbatim.

Ethical considerations

This study was carried out following approval by the Regional Ethical Review Board of the University of Gothenburg (application number: 671-14). All patients gave written informed consent.

Analysis

The transcripts were read to grasp a sense of the whole. The results from this first reading and the results from the randomized controlled study [18] were combined to structure the deductive content analysis [21,22]. Three questions were formed: 1) What does the effect of physical activity on GI symptoms mean to the patients, and how do the patients control their symptoms by using physical activity?, 2) What does physical activity mean to the patients' in relation to extra-intestinal symptoms? and 3) What does physical activity mean to the patients' in relation to QOL?

Each transcript was then systematically read with the three questions in mind. Exact statements were derived from the transcripts, each containing aspects related to each other by content and context. These statements constituted the meaning units. These units were each condensed by shortening the text and then labeled with a code to capture the meaning. This condensing and coding procedure maintained the meaning of the text while allowing the data to be seen in a new way [21]. Three of the authors coded the data. The meaning units extracted through questions 1) and 2) allowed for the analysis to be manifest, but the answers to question 3) needed to include interpretations of latent content in the analysis due to the more abstract character of the question.

Pre-understandings

The research group conducting the study consisted of four members, a female physiotherapist with experience of using physical activity in patient treatment in a variety of diagnoses, and two female registered nurses, one with a PhD and experience of working with IBS patient and the other is an associate professor with knowledge of qualitative research. The fourth member of the group is a male gastroenterologist and associate professor with experience of functional GI disorders.

Results

The analysis of the material revealed a total of nine subthemes, three corresponding to each question (Figure 1). In relation to GI symptoms, the patients discussed how physical activity affected these symptoms and how they used physical activity to normalize and control their symptoms. Extra-intestinal symptoms were also affected by physical activity, and the patients described how they experienced a general bodily wellbeing as well as improved mood and energy in relation to physical activity. In terms of QOL, the patients discussed their perspectives on physical activity as giving them achievements, being pleasurable, and being strengthening of the self.

Patients' experiences of effects of physical activity in relation to IBS		
Gastrointestinal symptoms	**Extra-intestinal symptoms**	**Quality of life**
Normalizing bowel movements	Flexibility, strength, and pain modulation	Overcoming weaknesses
Experiencing changes in abdominal pain	Modulating stress level and mood	Stimuli and distraction
Handling gas and bloating	Stabilizing energy	Self-strengthening

Figure 1. Patients' experiences of the effects of physical activity in relation to IBS: GI symptoms, extra-intestinal symptoms and QOL.

Physical activity in relation to GI symptoms

During the interviews, the patients discussed the overall effects of physical activity. They shared their experiences of general effects on GI symptoms, such as a general GI well-being from being physically active. This was expressed without specifying which symptom was improved; as one woman said, '… *getting moving certainly makes your tummy feel better*.' The patients discussed their experience of the effects in three subthemes: 1) *normalizing the bowel movements*, 2) *experiencing changes in abdominal pain* and 3) *handling gas and bloating*. Within these three subthemes, the patients described how they 'took control' of their bowel habits and made their bowels 'work'. When experiencing increased GI problems, they sometimes used physical activity to normalize their symptoms.

Normalizing bowel movements

Physical activity was described to affect bowel movements and stool consistency in different ways. The patients could control their bowel movements to some extent with physical activity, while inactivity could lead to increased GI symptoms.

Being physically active made it easier for some patients to be able to pass stool, and this contributed to a feeling of a more complete evacuation. One woman explained her experience of being physically active:

> *Yes, it means I have better, more frequent bowel movements, and then I feel better.*

Some patients who had problems with loose stools and fecal incontinence said their stool frequencies were lower when they were regularly physically active. However, others described an increase in bowel movements which could be bothersome, particularly in connection with activities which included running or jumping. One patient described this negative aspect as follows:

> *The, uh, the same thing happens after a while. Any physical activity gets the bowels going.*

Experiencing changes in abdominal pain

Many patients experienced a reduction in abdominal pain when they were physically active. This seemed to be due to physiological features, such as physical activity facilitating the passage of gas, and to changes in stool frequency and stool consistency. However, for some patients, the abdominal pain did not decrease during the activity, although they experienced a better feeling after the activity and/or a positive effect in a longer perspective.

> *But I've noticed that if I've had a stomach ache, regardless what I do, I often go out for a walk and afterwards I feel better.*

The patients reported knowledge about the characteristics of the abdominal pain, having found that different activities had different effects on different types of pain. They described a very conscious approach to abdominal pain; they knew which kind of pain could be relieved by physical activity and which kind of pain would get worse. Some said that their abdominal pain hindered them from physical activity.

Handling gas and bloating

The patients had found that the passage of gas was affected by physical activity or inactivity. Inactivity led to increased feelings of bloating, and sometimes pain was combined with the bloating. Physical activity could sometimes help to facilitate the passage of gas, which relieved the bloating and some of the pain.

> *Gas … um … you feel bloated, or your stomach grumbles, but it hurts … um … It's mainly that. But once I get moving, it goes away.*

One patient had learned that training of the core muscles could reduce the feeling of bloating. He described how the increased tension in the muscles after training could hold back the perceived bloating. When the patients experienced bloating, they sometimes had to refrain from or adjust their physical activity. One said that problems with gas made it difficult to participate in group activities because of the fear of passing gas during the activity. Another said that physical activity had no effect on bloating at all.

Physical activity in relation to extra-intestinal symptoms

The patients expressed experiences of a general wellbeing in the whole body in connection with physical activity. This wellbeing was connected both to physical experiences, such as one's body feeling good, and to more psychological impressions, such as a feeling of being at ease or feeling good in general.

Three subthemes emerged from the patient's discussions of their extra-intestinal symptoms: 1) *flexibility, strength, and pain modulating*, 2) *modulating stress level and mood* and 3) *stabilizing energy*. The first subtheme included the patients' experiences of how bodily experiences interrelated with feelings of wellbeing, while the other two were more focused on psychological wellbeing, which was described by the patients as involving both handling feelings of stress and experiencing less fatigue. Within the subthemes, the patients discussed the connection between the more concrete bodily feeling and the more abstract feeling of psychological well-being, and how they used their knowledge of this in relation to physical activity.

Flexibility, strength, and pain modulation

One example of the bodily experiences from physical activity reported by the patients was that their muscles and joints felt more flexible and less rigid. The patients described this in terms of physical activity strengthening the body and loosening up the muscles, and the body becoming warmer and more flexible.

> *And then your joints … Maybe if I just walk a bit more I'm not as stiff.*

The majority of the patients who had musculoskeletal pain said that physical activity was connected with decreased pain. However, a few patients said that physical activity could also increase this kind of pain. These patients were aware, through experience and knowledge, of how activities or ways of performing the activities should be balanced to prevent the experience of increased musculoskeletal pain.

Modulating stress level and mood

Some patients said that physical activity helped them relax and handle negative feelings; they had found that it helped them clear their thoughts for a while. This included being physically active on the way home from work, allowing them to leave their work-related thoughts. One man describes the effects of physical activity as follows:

Yes, it's good. It just winds everything down.

Some patients also found physical activity to be helpful during stressful periods and negative events in life. Physical activity could sometimes help them get into a better mood, by reducing feelings of anger and aggression. The patients shared experiences from situations when they were stressed or angry before performing an activity, and found that these feelings were less intrusive after the activity. For some patients, physical activity was a way to relax and recover when they felt stressed.

Stabilizing energy

The patients discussed fatigue, tiredness, energy, and sleep in relation to physical activity. Some said that physical activity gave them positive energy both in the short and in the long run, and some said that it gave them a way to get started. The patients described physical activity as producing a better feeling of tiredness, which in turn made it easier to fall asleep at night and improved the quality of night sleep. One woman described what she believed would happen if she was not physically active:

I don't think… I don't think I'd sleep as well. I don't think so. I think this activity… because activities during the day aren't the same as doing an intense work-out at this hour. I don't think I'd be able to sleep.

Some patients said that physical activity made them tired, and they needed to rest afterwards, but in the long run it had positive effects on their feelings of fatigue and lack of energy.

Physical activity in relation to QOL

The patients shared their experiences of managing and handling symptoms in relation to physical activity and reported an increased wellbeing connected to QOL. This connection consisted of the patients' perspectives on physical activity as giving them achievements, being pleasurable, and strengthening the self. Three subthemes emerged from these discussions: 1) overcoming weaknesses, 2) stimuli and distraction and 3) self-strengthening.

Some of the patients believed that these feelings were due to the release of positive hormones triggered by physical activity. They said that they missed these positive feelings during periods of inactivity.

Overcoming weaknesses

The patients expressed feelings of gratefulness towards their own bodies and the ability to get things done when being physically active. They shared how they felt pleased when they had performed an activity, speaking in terms of having done something which made sense to them. Some said that they had decided to see their physical activity in the light of what they had accomplished, even though sometimes their symptoms meant that they could not perform the activity the way they had planned. One woman explained her thoughts after exercising:

I'm not going to feel guilty about the times I didn't work out, because now I've done it anyway, so things only get better.

The patients felt grateful and pleased over their achievements in a philosophical manner, despite the limitations which came with IBS.

Stimuli and distraction

The patients described how physical activity included stimuli and impressions which added to the positive experience of physical activity. Physical activity was in these cases referred to as meditation, delight, and pleasure for the mind and the body. Some of these impressions came from the patients' own bodies, during or after the physical activity, and contributed to reduce the consciousness of the symptoms. The positive feelings were sometimes connected to surrounding factors and interests. Some of the patients described how they longed for physical activity, having found that physical activities distracted them from the pain, the bloating, and the negative feelings. One patient shared her view on taking walks in her local neighborhood:

Because it's beautiful there… I just have to go out and see it all and feel it. Somehow that's a trigger for me to start feeling better.

Self-strengthening

The patients saw physical activity as a way to claim their own space and time. By putting time aside to be physically active, they not only prioritized themselves but also showed to themselves and others the importance of their health and wellbeing. The patients described being physically active as a way to invest in themselves and to treat themselves. They considered it important that the physical activity was performed on their own terms, as one woman described:

It's, like, it's my time to do as I please – I just want to do it my way [laughs].

The patients expressed knowledge of positive effects on both health and wellbeing. Some of them had found that prioritizing physical activity during periods of stress or

negative events had strengthened them and helped them. However, some of them had also experienced an inability to be physically active when times were hard, even though they believed this was when they needed it the most.

Discussion

The results of this study give a nuanced picture of patients' experiences of the effects of physical activity on IBS. The patients described how they normalized their bowel movements, experienced changes in their abdominal pain, and handled gas and bloating through physical activity. The knowledge revealed in this study provides a new perspective and deepens the understanding of the results from quantitative studies on IBS and physical activity [18,19,23] as well as studies on GI symptoms and physical activity in general [24]. The patients sometimes used physical activity as a distraction from pain, or to enable the passage of gas and thus decrease the bloating they experienced. They also found that they were more likely to experience a complete evacuation when passing stool, which has also been demonstrated quantitatively in terms of symptom improvement on the IBS Severity Scoring System [18]. Some said that they sometimes used physical activity to 'take control' of their bowel.

One interesting observation of this study is that some patients with diarrhoea-predominant IBS also described a positive experience of bowel movement initiation from physical activity. Given this, it is important that the knowledge that physical activity can accelerate colonic transit should not always should lead to a general recommendation for patients with diarrhoea-predominant IBS to avoid physical activity. The clinician must remain conscious of how the patient describes the symptoms and whether they have any experiences of symptoms in relation to physical activity, and discuss this with the patient. We cannot assume that all patients experience the effects of physical activity in the same way, but we can use the results from this study in combination with results from other studies to guide the patient to find ways to be physically active.

The patients in this study shared how they experienced and managed different GI and extra-intestinal symptoms with physical activity. The presence of musculoskeletal symptoms was important when choosing an activity; sometimes it was a hindrance, as previously seen in a review on patients with rheumatoid arthritis [25]. The patients with IBS generally found that physical activity affected their musculoskeletal symptoms positively, and if they experienced negative effects then those experiences often led to adjustment of the activity.

The patients in this study expressed that depressive symptoms were positively affected by physical activity, and other kinds of distress, such as anger, could also be improved. Physical inactivity and depressive symptoms have an inverse dose–response association [26], and physical activity has known positive effects on physiological stress reactions [27]. Some patients in the current study described physical activity to be recreational, and therefore to have a positive effect on stress, but they also described physiological effects. This recreational aspect was also present in a review of qualitative studies of reasons and barriers for participating in physical activity and sports; enjoyment and social support were shown to be important reasons for such participation [28]. However, some patients in this study found it difficult to be physically active at times when they believed they needed it the most. It is likely, that in this situation extra support would be highly appropriate [29] for patients with IBS.

The patients described energy both as motivation to be physically active and, when lacking, as a barrier. This is in line with an earlier study [30] which found that fatigue was bothersome for patients with IBS; 22% of the patients said that fatigue interfered with physical training. Well-balanced physical activity can be positively experienced among patients with chronic fatigue syndrome, resulting in increased physical functioning and QOL [31]. The patients in the present study described physical activity as a way to take command and stabilize their energy. However, physical activity, at the same time required energy. A randomized controlled study showed no effect on fatigue after 12 weeks [18], but improvements in the physical and cognitive subscales of Fatigue Impact Scale were seen in the long term [19]. These varying results could be due to the different follow-up times, but could also be a sign that fatigue can be both motivational and a barrier for patients with IBS to be physically active. The mechanisms behind the experiences are unknown. However, the responses of the patients in this study suggest that the positive long-term effects of physical activity on fatigue could be due to improved quality of night sleep and long-term gain of energy. The patients in the present study also spoke about how the positive long-term experience could help them overcome the immediate barriers to being physically active. When coaching patients to increase their physical activity, it is important to emphasize that in order to experience the full positive effects on fatigue the patient needs to be active regularly and persistently for a period of time.

QOL seemed to be an important issue, as the patients in the present study frequently discussed QOL in relation to physical activity. Two previous studies did not show any significant change in QOL after increased physical activity in the short term [18,23], but a long-term follow-up study [19] revealed improvements in both general and disease-specific QOL. The patients' comments on QOL in the interviews fell within the presented subthemes of *overcoming weaknesses*, *stimuli and distraction*, and *self-strengthening*. It should be noted that the questionnaires used in the two quantitative studies (Short Form 36 and IBS QOL) [18,19] are primarily focused on questions about health, symptoms, how much pain is present, how physically fit the patient is, and how intrusive the symptoms are in the patient's life. The patients in this study described how they felt when they overcame their perceived weaknesses and spoke about gratefulness for what they had accomplished. This more philosophical experience is perhaps not captured by the questionnaires. In addition, the questionnaires ask the patients if they are limited in terms of their social lives, which can be seen against the background of how some patients in the present study

handled their situation by actively choosing to limit their social lives in favor of physical activity.

Jakobsson et al. [7] also found that self-centeredness and disciplined self-care could be a way for patients to take control over their situation. For IBS patients, self-centeredness, self-care, and self-strengthening are about creating their own space and claiming time for their own health and wellbeing, by being physically active or by other actions; this can, therefore, be supported during consultations with IBS patients. Our results suggest the use of a person-centered approach when coaching persons with IBS in physical activity. The coaching should take place in a partnership with the patient, helping them to achieve a more active lifestyle and thereby empowering them to cope with their symptoms in daily life. The importance of the patient's experiences should be emphasized when discussing physical activity or other treatment options [8,32]. Qualitative and quantitative methods can be used to complement one another and give a wider perspective on patients' views and what is important to patients in terms of being physically active. Clinicians, therefore, must be aware that patients' individual experiences can differ from what is seen in clinical trials on a group level. Mixed methods are likely to be a valuable approach in future studies on physical activity in IBS.

The patients in this study described a general wellbeing, both physical and psychological, in relation to physical activity. The questionnaires in the quantitative studies ask questions about experiences of health, happiness, and psychological symptoms, but when the patients described this feeling of general wellbeing they struggled to find an appropriate term, describing it as 'wellbeing' or 'feeling good'. It is possible that patients find this aspect hard to describe on a questionnaire containing pre-designed questions with pre-defined answers. However, these experiences are important to the individual patient in finding motivation to be physically active.

Study strengths and limitations

The patients recruited to the study had both positive and negative experiences of physical activity, which produced rich and nuanced descriptions in the interviews. The recruitment method ensured that all patients had experience of physical activity; however, the severity of IBS symptoms among these patients can be assumed to be higher than among IBS patients in general, since the patients in the study had been referred to a specialized clinic. Both men and women were included, with different backgrounds, lifestyles, and ages, ensuring variation in the sample. There were more women than men which is representative for the IBS population. In the present study the analysis was not aimed to reveal differences according to sex or gender. A qualitative study which explored the impact of gender differences presented the patients' experience of IBS in daily life to differ between men and women [33]. All three types of IBS were represented but a more even distribution of symptom predominance would have been preferred. A wider recruitment could perhaps have given an even higher variation and added extra assurance of transferability.

Conclusion

Our results emphasize the importance of taking into account the patient's experiences of the effects of physical activity when coaching patients with IBS to be physically active. Using a person-centred approach incorporating, the patient's own experiences and resources is the key to successfully promoting physical activity in the clinic.

Disclosure statement

The authors declare that they have no conflict of interests.

Funding

The study was funded by The Health and Medical Care Executive Board of the Västra Götaland Region and The Local Research and Development Council, Södra Älvsborg. Grant number: VGFOUREG-226761, VGFOUREG-293471, VGFOUREG-386221, VGFOUSA-423261, VGFOUSA-675481 and VGFOUSA-763901.

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Cytokine 102 (2018) 18–25

Contents lists available at ScienceDirect

Cytokine

journal homepage: www.elsevier.com/locate/cytokine

Low-to-moderate intensity aerobic exercise training modulates irritable bowel syndrome through antioxidative and inflammatory mechanisms in women: Results of a randomized controlled trial

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ARTICLE INFO

Keywords:
Exercise intervention
Inflammation
Irritable bowel syndrome
Randomized controlled trial
Redox homeostasis
Oxidative stress

ABSTRACT

Our aim was to explore the putative beneficial effects of low-to-moderate intensity exercise training program in patients with irritable bowel syndrome (IBS). This study evaluated the changes in blood oxidative stress status, inflammatory biomarkers and IBS severity symptoms following 24 weeks of moderate aerobic exercise in sedentary IBS patients. A total of 109 female volunteers (aged 18–41 yrs) who fulfilled Rome III criteria for the diagnosis of IBS were screened and 60 were randomized to exercise (EX, n = 30) and non-exercise (NON-EX, n = 30) groups. Exercise intervention favorably attenuated inflammation as indicated by plasma cytokines (IL-1β, IL-6, IL-8, IL-10 and TNF-α), adenosine deaminase, oxidative stress (XO, MDA and NO) and enhanced antioxidants (SOD, CAT and GSH-Px) ($P < .05$), and these alterations correlate with promising improvements in IBS symptoms ($P < .05$). Taken together, low-to-moderate intensity exercise training program attenuates symptoms in IBS. Symptom improvement was associated with a reversal of the ratio of anti- to pro-inflammatory cytokines as well as facilitating blood redox homeostasis, suggesting an immune- and redox modulating function for exercise training.

1. Introduction

Irritable bowel syndrome (IBS) is a common functional bowel disorder characterized through recurrent abdominal pain, diarrhea, constipation, discomfort, bloating, and an alteration in bowel habit [1]. IBS affects 5–20% of population globally with a high prevalence in females younger than 50 years of age [1]. The etiology of IBS is unclear and multiple mechanisms have been proposed to explain the pathogenesis of the disease [2]. Though IBS is not classified as an inflammatory disease, recent investigations have demonstrated increased ratio of pro- [3] to anti-inflammatory [4] cytokines in IBS patients; and found strong associations between pro- and anti-inflammatory cytokines with IBS symptoms [4,5]. There is also evidence that changes in pro-antioxidant ratio towards peroxidation may be a contributing factor and may have a role in the pathogenesis of IBS and inflammatory bowel disorders [6,7]. These data, thus, support the notion that attempts toward optimizing oxidant/antioxidant equilibrium and an attenuation of pro-/ant-inflammatory mediators may have beneficial health effects in IBS patients.

Regular physical activity and exercise may be one lifestyle approach to reduce systemic low-grade inflammation [8] and to induce adaptive responses in redox-sensitive pathways [9] thereby lowering the risk for chronic diseases [10,11]. Several studies have shown that following regular physical activity, markers of inflammation [8,10,11] and oxidative stress [10,12] are reduced, while anti-inflammatory [10] and antioxidant [10,12] markers are increased, reinforcing the anti-inflammatory and antioxidant nature of physical activity. Findings further suggest an inverse relationship between physical activity and risk

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https://doi.org/10.1016/j.cyto.2017.12.016
Received 25 April 2017; Received in revised form 12 December 2017; Accepted 14 December 2017
Available online 21 December 2017

of gastrointestinal-related disease [13–15]. It has also been suggested that physical activity of light-to-moderate intensity can benefit IBS symptoms in these patients [14,15].

Therefore, considering the well-known anti-inflammatory and antioxidant properties of physical activity and its role in the management of IBS symptoms, and the association between inflammatory and OS parameters with IBS symptoms, we hypothesized that (1) physical activity would be successful in decreasing chronic inflammation and OS in previously sedentary IBS patients; and (2) those changes in circulating pro- and anti-inflammatory cytokines as well as pro and antioxidant parameters would be correlated to improvements in IBS symptoms. Thus, we conducted a randomized controlled trial to examine the effects of 24 weeks of moderate aerobic exercise training on pro- and anti-inflammatory cytokines, peroxidative and antioxidative biomarkers as well as symptom severity in sedentary IBS patients. To our knowledge, this is the first longitudinal study to address this issue in IBS patients.

2. Materials and methods

2.1. Patients

One hundred and nine women (aged 18–41 yrs) from the outpatient clinic of the Department of Internal Medicine of the University Hospital in Urmia, Iran, were screened through detailed medical history questionnaire, fasting blood profile, physical examination, as well as a treadmill graded exercise test to exclude those with cardiovascular disease. All were non-smokers, free of clinically important systemic diseases as well as organic gastrointestinal diseases, including inflammatory bowel disease, had not taken antioxidants as supplements or underwent any abdominal surgery excluding hernia repair and appendectomy (> 3 months). Those with co-morbid conditions that would influence markers of inflammation and any known respiratory, cardiovascular, endocrine, metabolic disorders, or conditions that might change markers of inflammation and oxidative stress, as well as individuals participating in a regular physical activity (for a minimum of 6 months prior to the study) or accumulating 25 min or more of physical activity of moderate intensity on most days of the week, pregnant individuals, women with recognized immunodeficiency or lactose intolerance, excessive obesity, psychiatric illness, alcohol and substance abuse or dependence, or those unable to increase their level of physical activity were excluded from the study.

2.2. Experimental design

Eligible participants who fulfilled Rome III criteria for the diagnosis of IBS [1] (n = 60) provided written informed consent and were then randomly assigned to either exercise (EX, n = 30) or control (NON-EX, n = 30) group (Table 1). With an $\alpha = 0.05$, an effect size = 0.91 and a power of 0.95, a sample size of 30 was proposed. Random number generation was used for randomization in which, at the time of randomization, sealed envelope containing group assignment was opened by the study coordinator. The study protocol was approved by the Urmia University of Iran Human Subject Internal Review Board committee according to the Helsinki declaration and conducted in an Exercise Physiology Laboratory. Patients were asked to avert any prescriptive or over the counter medications/supplements and foods known to affect the gastrointestinal tract or the immune system over the course of the study. Nine patients (EX, n = 6; NON-EX, n = 3) were unable to complete the study protocol, the remaining 51 patients were included in the analysis (Fig. 1).

2.3. Exercise intervention

Baseline testing included a maximal oxygen uptake (VO_{2max}) by means of an automated breath-by-breath system (CPX, Medical Graphics, St. Paul, MN, USA). Over the first 12 weeks of the intervention, patients in the EX group walked or jogged (between 0600 and 0800) on a treadmill at 45–55% of their VO_{2max} (25–30 min/day, 3–4 days/week), and after that exercised at an intensity of 56–69% of VO_{2max} (40–45 min/day, 4–6 days/week) over the final 12 weeks. Exercise adherence was recognized using Polar heart rate monitors, and patients were given feedback to modify to the prescribed exercise intensity. Patients in the NON-EX group were required to keep their present physical activity levels over the study as described before [11].

2.4. Dietary and medication intake measures

At baseline and 60 days post training, dietary data was collected by trained dietitians by means of a validated semi-quantitative food frequency questionnaire (FFQ) [12]. Patients were instructed to preserve their normal diet over the study period and to consume a diet as similar as feasible in each sampling day. Further, standard and self-reported questionnaires were used to collect information on use of medications and supplements during the period of study.

2.5. Biochemical analysis

At baseline, the end of week-12 and 24, and 30 and 60 days post exercise, all patients were transported to the lab (between 0700 and 0800), and 20 ml blood samples were drawn in tubes containing ethylenediaminetetraacetic acid (BD Caribe LTD, San Lorenzo, Puerto Rico). Patients were fasting (except for water) for 12 h and free of exercise at least 24 h in advance of the sampling. Plasma was collected and preserved at −80 °C to analyze within a week. Blood samples were analyzed for plasma superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GSH-Px), xanthine oxidase (XO), adenosine deaminase (AD) activities, and malondialdehyde (MDA), nitric oxide (NO), IL-1β, IL-6, IL-8, IL-10 and TNF-α concentrations.

2.5.1. XO activity assay

Activity of plasma XO was measured at 293 nm and 37 °C with a Gilford model 2400-s automatic recording spectrophotometer with xanthine as substrate [16]. XO was assessed through the enhancement in absorbance as a result of uric acid accumulation. XO activity was calculated in μmol uric acid produced per minute at 37 °C, pH 7.5.

2.5.2. AD activity assay

Plasma activity of AD was assessed spectrophotometrically at 620 nm and 37 °C by the method of Giusti [17] with adenosine as substrate. The formation of ammonia from adenosine causes raise in

Table 1
Individual characteristics of IBS patients.

	Age (yr)	Height (m)	Weight (kg)	BMI (kg/m^{-2})	Fat (%)	VO_{2max} (ml/kg/min)
EX	33.9 ± 8.6	1.60 ± 0.15	64.3 ± 6.4	25.1 ± 3.5	28.9 ± 4.9	35.0 ± 4.3
NON-EX	34.1 ± 6.4	1.60 ± 0.18	64.8 ± 7.7	25.3 ± 3.1	29.1 ± 5.2	35.2 ± 3.7
P value	0.134	0.085	0.142	0.079	0.121	0.092

BMI = body mass index; VO_{2max} = maximal oxygen uptake.
Values are mean ± SD.

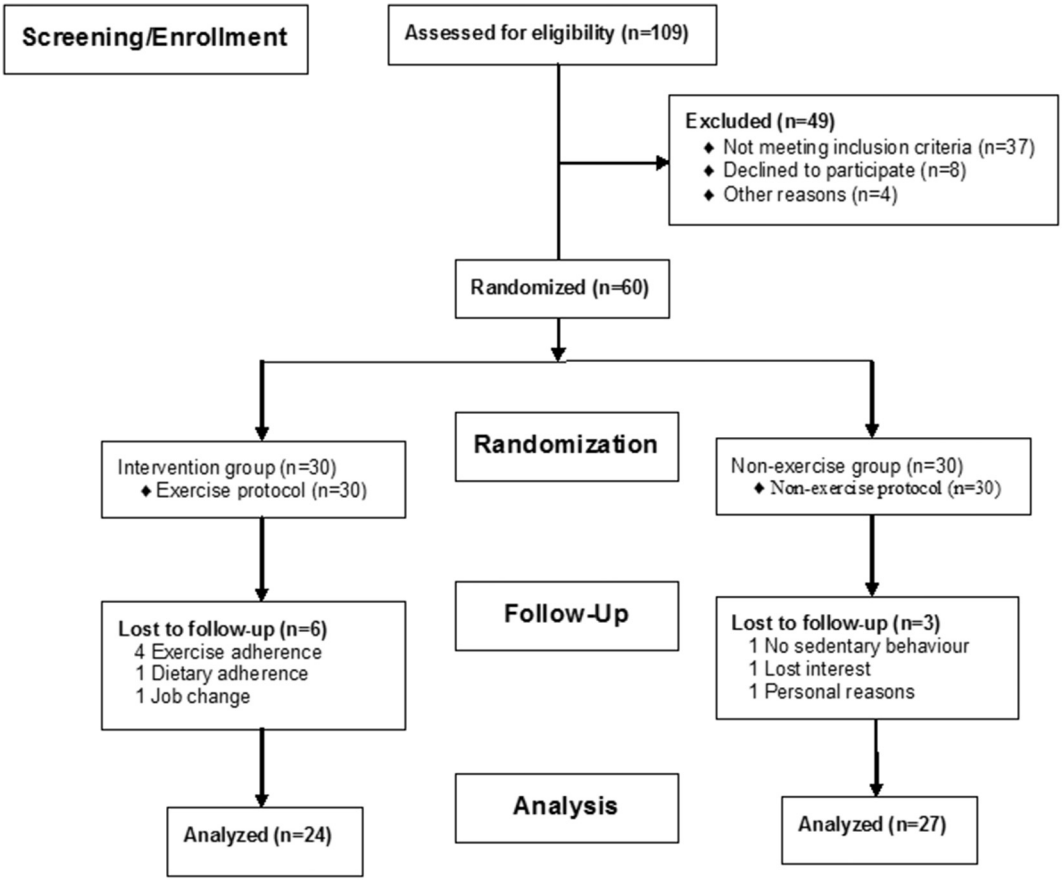

Fig. 1. Follow-up diagram.

absorbency. Results are reported as U/l.

2.5.3. NO assay

As an index of NO production sample nitrite and nitrate concentrations were used to detect NO based on the Griess reaction [18]. Briefly, after deproteinization with Somogyi reagent, nitrate converted to nitrite by means of copperized cadmium granules then total nitrite (nitrite + nitrate) was assessed spectrophotometrically at 545 nm. A set of serial dilutions of sodium nitrite then was utilized to form a standard curve. Through the peak area from the nitrite standard linear regression was performed and the concentration of NO was then calculated by the resulting equation.

2.5.4. MDA assay

Concentrations of MDA were determined using the procedure of Draper and Hadley [19], based on the reaction of MDA with thiobarbituric acid (TBA) to produce a pink pigment with an absorption maximum at 532 nm and 95 °C for 15 min, pH 2–3. Initially the sample was combined with 2.5 volumes of 10% (w/v) trichloroacetic acid and centrifuged then supernatant was reacted with TBA (0.67%) for 15 min in a boiling water bath. The absorbance was read after cooling and acquired arbitrary values were compared against a sequences of standard solutions (1,1,3,3 tetramethoxypropane).

2.5.5. SOD activity assay

Total SOD activity was measured based on the methodologies described in the literature [20] with xanthine - xanthine oxidase system as a superoxide generator. Initially 1.0 ml of sample was mixed with the same volume of ethanol/chloroform blend (5/3, v/v) and centrifuged, then activity was measured in the sample (in the ethanol phase). Inhibition of nitroblue tetrazolium reduction rate was indicative of one unit alterations in SOD.

2.5.6. GSH-Px activity assay

GSH-Px activity was assessed spectrophotometrically at 340 nm according to the procedure represented earlier by Paglia and Valentine [21]. The enzymatic reaction was commenced by means of addition of H_2O_2 to the tube, containing NADPH, reduced glutathione (GSH), sodium azide, and glutathione reductase, and the alteration in absorbance was detected via spectrophotometr.

2.5.7. CAT activity assay

CAT activity was evaluated based on the previously described method suggested by Aebi [22]. The analysis was based on the calculation of the rate constant of the H_2O_2 decomposition at 240 nm.

2.5.8. Cytokine assay

Plasma IL-1β, IL-6, IL-8, IL-10, and TNF-α measurements were performed via an electrochemiluminescence multiplex system Sector 2400 imager (MSD, Gaithersburg, MD, USA) in which Sulfo-tag reagents reagent emitted light were used to label antibodies upon electrochemical stimulation. The lower limits of detection for IL-1β, IL-6, IL-8, IL-10, and TNF-α were 0.1 pg/mL, 0.3 pg/mL, 0.1 pg/mL, 0.2 pg/mL, and 0.5 pg/mL, respectively.

2.6. Evaluation of symptom severity

IBS severity was evaluated by means of the IBS Severity Scoring System (IBS-SSS) consists of visual analog scales [23].

2.7. Statistical analysis

Data analysis was carried out using SPSS 23.0 software (SPSS, Inc., Chicago, IL, USA). All data are showed as means ± standard deviation (SD) and examined for normality by means of a Kolmogorov-Smirnov and Q-Q plot. Differences between the groups were evaluated by unpaired Student's *t*-test. To evaluate the changes from baseline within the groups paired Student's *t*-test was employed. Also, partial correlation and mixed model regression coefficients were utilized to evaluate the association, direction and magnitude of interactions between the variables studied as well as strength and direction of a linear relationship between two continuous variables whilst controlling for the effect of one or more other continuous variables. Statistical significance was set at $P \leq .05$.

3. Results

3.1. Baseline characteristics

Body weight, body mass index (BMI) and body fat decreased ($P < .05$) and VO_{2max} increased ($P < .05$) after 24 wks of aerobic exercise in EX group. There were slight but non-significant elevations in these parameters at 24 wks in the NON-EX group ($P < .05$) (Fig. 2).

3.2. Dietary and medication intake

The quality, quantity and frequency of consumption of food were similar in both groups at baseline ($P > .05$). Energy, proteins, carbohydrates and fat intakes decreased significantly following 24 wks of aerobic exercise in the EX group ($P < .05$) (Table 2).

3.3. Cytokines

IL-1β and IL-6 decreased at 12 and 24 wks relative to baseline levels ($P < .05$). Values remained significantly lower after 60 days post exercise ($P < .05$). IL-8 and TNF-α decreased at 24 wks compared to baseline and remained significantly lower after 60 days post exercise ($P < .05$). In the EX group, IL-10 levels elevated from baseline at 12 and 24 wks and returned to basal values 30 days post exercise ($P < .05$). Cytokines did not show any significant changes from baseline in the NON-EX group over the course of the study ($P > .05$) (Table 3).

3.4. AD activity

AD enzymatic activity significantly decreased at 12 and 24 wks relative to baseline, and remained significantly lower 60 days post exercise ($P < .05$) (Table 3).

3.5. Oxidants and antioxidants

SOD and GSH-Px activity increased at 12 and 24 wks relative to baseline ($P < .05$). Changes in both levels remained significantly higher 60 days post exercise ($P < .05$). Increases in CAT enzymatic activity was observed in the EX group at 24 wks relative to baseline, and returned to basal values 30 days post exercise ($P < .05$). Decreases

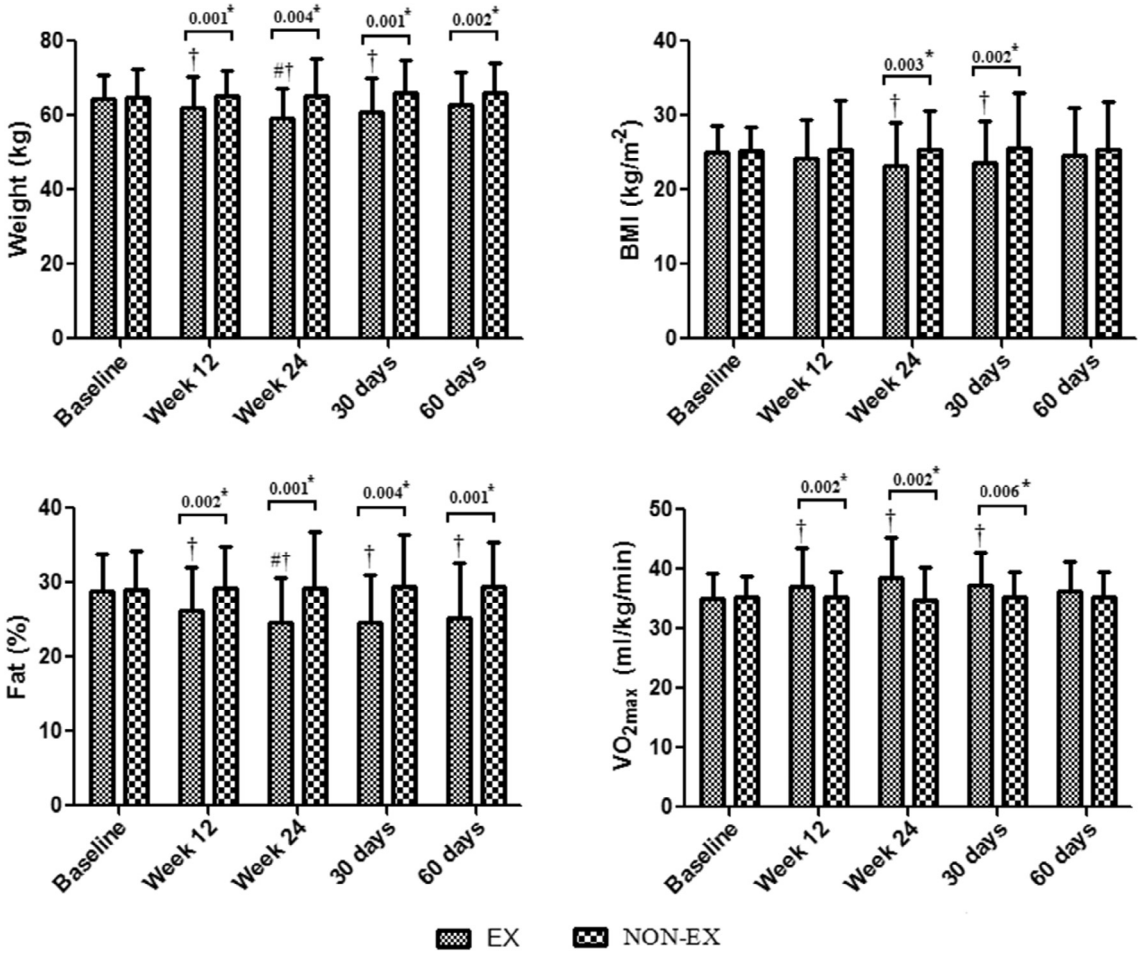

Fig. 2. Changes in body composition and VO_{2max} in the EX and NON-EX groups during the course of the study. †: $P < .05$, significantly different from baseline values. * $P < .05$, significant difference between the groups. #: $P < .05$, significantly different from week 12 values (within groups, week 12 vs. week 24).

Table 2
Differences in dietary intakes for the patients.

		EX	NON-EX	P value
Energy intake (kcal)	Pre	2257 ± 521	2261 ± 490	ns
	Post	2026 ± 487†	2272 ± 509	0.02*
Proteins (g)	Pre	81.4 ± 26	78.2 ± 21	ns
	Post	69.8 ± 31†	78.7 ± 19	0.03*
Percent energy from proteins	Pre	13.7 ± 3.4	13.9 ± 2.9	ns
	Post	14.1 ± 3.2	13.8 ± 3.0	ns
Carbohydrates (g)	Pre	331.0 ± 104	342.5 ± 99	ns
	Post	306.4 ± 98†	345.6 ± 88	0.01*
Percent energy from carbohydrates	Pre	54.2 ± 6.3	54.2 ± 5.8	ns
	Post	55.7 ± 5.6	54.6 ± 6.1	ns
Fat (g)	Pre	66.5 ± 15.3	63.2 ± 16.3	ns
	Post	57.1 ± 16.4†	63.5 ± 15.7	0.04*
Percent energy from fat	Pre	25.6 ± 5.4	26.1 ± 5.3	ns
	Post	24.1 ± 6.1	25.7 ± 6.2	ns
Dietary fiber (g)	Pre	17.0 ± 6.9	17.4 ± 7.2	ns
	Post	17.6 ± 5.6	17.2 ± 6.7	ns
Saturated fat (g)	Pre	35.1 ± 9.2	35.5 ± 5.9	ns
	Post	34.5 ± 8.6	35.0 ± 5.1	ns
Monounsaturated fat (g)	Pre	39.4 ± 8.7	40.1 ± 6.9	ns
	Post	38.9 ± 6.7	39.5 ± 7.2	ns
Polyunsaturated fat (g)	Pre	14.8 ± 6.2	15.2 ± 5.9	ns
	Post	15.1 ± 5.3	15.0 ± 6.3	ns
Cholesterol (mg)	Pre	354.2 ± 74	355.9 ± 79	ns
	Post	353.9 ± 81	354.5 ± 78	ns
Vitamin C (mg)	Pre	63.1 ± 37.1	62.3 ± 33.9	ns
	Post	64.0 ± 39.0	63.6 ± 38.1	ns
α-tocopherol (mg)	Pre	4.6 ± 1.2	4.8 ± 1.4	ns
	Post	5.1 ± 1.3	5.0 ± 1.2	ns
Vitamin A (RE μg)	Pre	1047.0 ± 295	1037.0 ± 302	ns
	Post	1038 ± 317	1041 ± 367	ns
Riboflavin (mg)	Pre	1.2 ± 0.3	1.3 ± 0.4	ns
	Post	1.2 ± 0.4	1.2 ± 0.4	ns
Folate (μg)	Pre	214.0 ± 55.7	219.0 ± 61.4	ns
	Post	216 ± 45.2	218.1 ± 56.9	ns
Thiamin (mg)	Pre	1.3 ± 0.3	1.3 ± 0.5	ns
	Post	1.4 ± 0.4	1.4 ± 0.3	ns
Niacin (mg)	Pre	12.0 ± 4.3	11.7 ± 4.8	ns
	Post	12.2 ± 3.6	12.1 ± 4.2	ns
Vitamin B_6 (mg)	Pre	1.3 ± 0.4	1.4 ± 0.3	ns
	Post	1.3 ± 0.3	1.3 ± 0.3	ns
β-carotene (μg)	Pre	632.0 ± 214	628.0 ± 236	ns
	Post	627 ± 198	624 ± 206	ns
Selenium (μg)	Pre	101.6 ± 19.3	99.0 ± 20.1	ns
	Post	98.8 ± 16.9	100.0 ± 21.4	ns
Zinc (mg)	Pre	16.8 ± 6.3	17.1 ± 5.9	ns
	Post	16.9 ± 5.9	16.7 ± 6.1	ns
Copper (mg)	Pre	1.1 ± 0.3	1.2 ± 0.3	ns
	Post	1.2 ± 0.3	1.2 ± 0.4	ns
Iron (mg)	Pre	12.7 ± 5.3	13.0 ± 6.1	ns
	Post	12.4 ± 6.4	12.9 ± 5.3	ns
Magnesium (mg)	Pre	260.0 ± 59	259.3 ± 61	ns
	Post	261.1 ± 66	260.8 ± 57	ns
Manganese (mg)	Pre	2.2 ± 0.5	2.3 ± 0.5	ns
	Post	2.3 ± 0.4	2.3 ± 0.5	ns

Values are mean ± SD.
* $P < .05$, significant difference between the groups.
† $P < .05$, significantly different from baseline values (within groups, baseline vs. 60 days post training).

in XO enzymatic activity was observed in the EX group at 12 and 24 wks relative to baseline, and returned to basal values 30 days post exercise ($P < .05$). Decreased NO levels were observed in the EX group at 12 and 24 wks in relative to baseline and remained significantly lower 60 days post exercise ($P < .05$). At 24 wks, MDA levels had decreased from baseline in the EX group and returned to basal values 30 days post exercise ($P < .05$). Oxidants and antioxidants did not show any significant changes from baseline in the NON-EX group over the course of the study ($P > .05$) (Table 3).

3.6. Symptom severity

EX group overall IBS score and overall extracolonic score declined at 12 and 24 wks and remained significantly lower 30 days post exercise ($P < .05$). These scores did not show any significant changes in the NON-EX group over the course of the study ($P > .05$) (Table 4).

3.7. Correlations

In both groups, a significant negative correlation was observed between the overall severity of IBS with VO_{2max}, SOD activity, GSH-Px activity, CAT activity and IL-10. A mixed model regression showed that for each unit increases in VO_{2max}, SOD activity, GSH-Px activity, CAT activity and IL-10 concentration there were a decrease in overall severity of IBS. Also, a significant negative correlation was observed between the overall extracolonic score with VO_{2max}, SOD activity, GSH-Px activity, CAT activity and IL-10. For each unit increases in VO_{2max}, SOD activity, GSH-Px activity, CAT activity and IL-10 concentration there were decrease of units in overall extracolonic score (Table 5).

Moreover, both groups demonstrated significant correlations between overall severity of IBS with measures of body composition, cytokines, oxidant and antioxidant enzymes. Further, for each unit decrease in measures of body composition, cytokine, oxidant and antioxidant enzyme concentrations, there were decreased units in overall severity of IBS (Table 5). Likewise, significant correlations were observed between overall severity of IBS with measures of body composition, cytokines, oxidant and antioxidant enzymes. Also, for each unit decrease in IBS with measures of body composition, cytokines, oxidant and antioxidant enzymes concentrations, there were decreased units in overall severity of IBS (Table 5).

4. Discussion

We report the findings from a randomized, controlled trial evaluating moderate aerobic exercise training as a treatment option for IBS. Study findings clearly show that aerobic exercise provides benefits on symptom severity in patients with IBS. Our data demonstrated that plasma pro-inflammatory cytokines and peroxidative biomarkers were attenuated with 24 weeks of moderate intensity aerobic exercise, while plasma concentrations of anti-inflammatory and antioxidant parameters were enhanced. In addition, IBS symptom severity was improved with regular exercise training, and changes in inflammation and redox homeostasis, in both groups combined, correlated with symptom severity.

Recent investigations on cytokine profiles in IBS patients support the hypothesis of immune activation and a disturbance in pro-/anti-inflammatory cytokines in adults with this syndrome [24]. Furthermore, higher gene expressions of pro-inflammatory cytokines, with low levels of anti-inflammatory mediators have been reported in a cohort of IBS patients compared to healthy controls [24]. Published data also support a correlation between IBS and disturbance in redox homeostasis [6]. It has been proposed that both oxidative stress [25] and inflammatory status [26] can aggravate changes in epithelial secretion, motility, permeability, intestinal sensitivity, and may therefore exacerbate symptoms of IBS. These findings underscore the significance of considering inflammatory and cellular redox pathways as therapeutic targets in the control or treatment of IBS.

This study demonstrated that aerobic exercise training resulted in significant decreases in proinflammatory cytokines *IL-1β, IL-6, IL-8* and *TNF-α* at both 12 and 24 weeks post exercise. To our knowledge, no reports have examined plasma cytokines response to exercise training in patients with IBS. Conversely, there is some data that aerobic exercise training is anti-inflammatory and protective against developing chronic diseases that have a pathophysiologically important inflammatory component [11]. We previously reported findings that a similar moderate intensity aerobic exercise protocol in postmenopausal

Table 3
Plasma concentrations and activities of cytokines, oxidant and antioxidant enzymes during the course of the study.

		Baseline	Week 12	Week 24	Recovery (30 days)	Recovery (60 days)
IL-1β (pg/mL)	EX	2.8 ± 0.7	2.0 ± 0.4†	0.9 ± 0.3$^{\#,\dagger}$	1.1 ± 0.5†	1.7 ± 0.6†
	NON-EX	2.9 ± 0.8	2.8 ± 0.9	2.8 ± 0.7	2.9 ± 0.6	2.8 ± 0.6
	P value	0.103	0.002*	0.001*	0.001*	0.001*
IL-6 (pg/mL)	EX	5.4 ± 0.9	4.1 ± 0.7†	2.2 ± 0.5$^{\#,\dagger}$	2.7 ± 0.6†	3.4 ± 0.7†
	NON-EX	5.3 ± 0.8	5.3 ± 0.6	5.2 ± 0.9	5.4 ± 0.5	5.4 ± 0.6
	P value	0.096	0.001*	0.002*	0.001*	0.001*
IL-8 (pg/mL)	EX	13.6 ± 2.9	13.5 ± 2.1	10.1 ± 1.1$^{\#,\dagger}$	10.8 ± 1.3†	12.0 ± 1.8†
	NON-EX	13.6 ± 2.5	13.5 ± 1.7	13.5 ± 3.0	13.6 ± 2.2	13.6 ± 2.4
	P value	0.079	0.123	0.002*	0.001*	0.001*
IL-10 (pg/mL)	EX	5.2 ± 1.7	5.7 ± 1.8†	6.4 ± 1.9$^{\#,\dagger}$	5.9 ± 1.3†	5.3 ± 1.4
	NON-EX	5.1 ± 1.9	5.0 ± 1.4	5.2 ± 1.4	5.1 ± 0.9	5.2 ± 1.1
	P value	0.096	0.004*	0.003*	0.004*	0.086
TNF-α (pg/mL)	EX	8.1 ± 1.4	8.0 ± 1.7	6.3 ± 1.2$^{\#,\dagger}$	7.0 ± 1.6†	7.4 ± 1.3†
	NON-EX	8.0 ± 1.7	8.0 ± 1.2	8.1 ± 1.5	8.0 ± 1.4	8.1 ± 1.1
	P value	0.142	0.117	0.001*	0.002*	0.002*
SOD activity (U/ml)	EX	10.8 ± 3.7	11.4 ± 3.9†	13.9 ± 2.7$^{\#,\dagger}$	12.8 ± 4.3†	11.9 ± 4.1†
	NON-EX	10.7 ± 3.1	10.8 ± 3.3	10.8 ± 2.5	10.6 ± 2.1	10.7 ± 2.3
	P value	0.106	0.009*	0.006*	0.003*	0.007*
GSH-Px activity (U/l)	EX	43.7 ± 10.7	47.3 ± 11.8†	53.7 ± 12.1$^{\#,\dagger}$	50.6 ± 10.9†	46.1 ± 11.2†
	NON-EX	43.9 ± 11.9	43.9 ± 12.5	44.0 ± 14.9	43.8 ± 13.6	43.8 ± 12.4
	P value	0.082	0.005*	0.001*	0.003*	0.006*
CAT activity (k/L)	EX	5.3 ± 1.2	5.5 ± 1.6	6.4 ± 1.4$^{\#,\dagger}$	5.4 ± 1.9	5.4 ± 1.3
	NON-EX	5.2 ± 1.4	5.3 ± 1.7	5.2 ± 1.2	5.3 ± 1.1	5.3 ± 1.2
	P value	0.107	0.083	0.005*	0.071	0.087
AD activity (U/l)	EX	20.4 ± 4.9	19.0 ± 6.1†	16.1 ± 5.9$^{\#,\dagger}$	18.2 ± 6.8†	19.3 ± 6.8†
	NON-EX	20.8 ± 5.2	20.2 ± 6.3	20.5 ± 4.5	20.4 ± 6.4	20.6 ± 7.2
	P value	0.099	0.001*	0.004*	0.008*	0.001*
XO (U/l)	EX	1.71 ± 0.47	1.49 ± 0.52†	1.32 ± 0.35†	1.67 ± 0.39	1.74 ± 0.28
	NON-EX	1.66 ± 0.52	1.69 ± 0.50	1.62 ± 0.47	1.65 ± 0.48	1.70 ± 0.33
	P value	0.086	0.006*	0.005*	0.075	0.091
NO (μmol/l)	EX	14.3 ± 3.7	13.2 ± 4.1†	10.4 ± 3.6$^{\#,\dagger}$	12.2 ± 3.1†	13.4 ± 3.6†
	NON-EX	14.2 ± 3.9	14.2 ± 4.2	14.3 ± 3.9	14.1 ± 4.2	14.2 ± 4.3
	P value	0.114	0.007*	0.009*	0.005*	0.007*
MDA (μmol/l)	EX	1.74 ± 0.4	1.71 ± 0.4	1.44 ± 0.3†	1.70 ± 0.3	1.75 ± 0.4
	NON-EX	1.76 ± 0.3	1.75 ± 0.6	1.73 ± 0.5	1.75 ± 0.4	1.77 ± 0.3
	P value	0.080	0.072	0.007*	0.069	0.085

All values are mean ± SD.
† P < .05, significantly different from baseline values.
* P < .05, significant difference between the groups.
$^{\#}$ P < .05, significantly different from week 12 values (within groups, week 12 vs. week 24).

Table 4
IBS-Severity Scoring System, IBS score and extracolonic score in the EX and NON-EX groups during the course of the study.

		Baseline	Week 12	Week 24	Recovery (30 days)	Recovery (60 days)
Overall IBS score	EX	328.5 ± 64.2	290.0 ± 59.1†	234.1 ± 49.2$^{\#,\dagger}$	263.6 ± 52.4†	296.0 ± 61.2†
	NON-EX	329.7 ± 67.1	329.2 ± 66.3	328.3 ± 57.8	330.7 ± 66.3	331.8 ± 66.3
	P value	0.092	0.001*	0.001*	0.001*	0.001*
Overall extracolonic score	EX	314.7 ± 75.6	266.3 ± 78.0†	211.7 ± 67.2$^{\#,\dagger}$	242.1 ± 57.6†	263.3 ± 65.3†
	NON-EX	321.4 ± 56.8	326.9 ± 58.1	315.7 ± 60.7	328.8 ± 69.9	318.3 ± 81.4
	P value	0.101	0.003*	0.001*	0.001*	0.002*

All values are mean ± SD.
† P < .05, significantly different from baseline values.
* P < .05, significant difference between the groups.
$^{\#}$ P < .05, significantly different from week 12 values (within groups, week 12 vs. week 24).

women can reduce systemic inflammation and can provides numerous benefits on bone density [11]. Moreover, six months of regular walking exercise in predialysis chronic kidney disease patients, has been suggested to induce reductions in the ratio of plasma IL-6 to IL-10 values as well as a downregulation of T-lymphocyte and monocyte activation [27]. Together, these studies propose that regular aerobic exercise has the potential to attenuate concentrations of markers of inflammation in patients with chronic diseases. The anti-inflammatory properties of regular exercise training may partially explained by exercise-induced increases of plasma levels of anti-inflammatory cytokine IL-10 as well as alterations in the expressions of anti- and pro-inflammatory cytokines in favor of the former across body fluids, organs and tissues [28].

This study also demonstrated that moderate intensity exercise training resulted in significant improvements in VO_{2max}, BMI and

Table 5
Correlation of the overall IBS severity score with cytokines, oxidant and antioxidant enzymes.

	Overall IBS severity			Overall extracolonic score		
		Regression			Regression	
	Correlation	RC	*P <	Correlation	RC	*P <
Weight (kg)	0.519	18.8	0.001*	0.541	20.6	0.002*
BMI (kg/m^{-2})	0.362	47.9	0.003*	0.336	51.5	0.001*
Fat (%)	0.687	23.5	0.001*	0.654	25.8	0.002*
VO_{2max} (ml/kg/min)	−0.509	−26.9	0.002*	−0.487	−29.4	0.001*
IL-1β (pg/mL)	0.692	47.0	0.001*	0.676	51.5	0.001*
IL-6 (pg/mL)	0.598	29.4	0.001*	0.612	32.2	0.002*
IL-8 (pg/mL)	0.482	62.7	0.001*	0.514	68.7	0.001*
IL-10 (pg/mL)	−0.264	−78.3	0.004*	−0.341	85.8	0.003*
TNF-α (pg/mL)	0.649	52.2	0.001*	0.655	57.2	0.001*
SOD activity (U/ml)	−0.628	−30.3	0.001*	−0.604	33.2	0.002*
GSH-Px activity (U/l)	−0.529	−9.4	0.001*	−0.548	13.0	0.001*
CAT activity (k/L)	−0.561	−85.5	0.001*	−0.575	93.6	0.001*
AD activity (U/l)	0.417	21.9	0.002*	0.401	24.0	0.001*
XO (U/l)	0.404	235.0	0.002*	0.378	257.5	0.001*
NO (μmol/l)	0.329	23.5	0.001*	0.345	25.8	0.002*
MDA (μmol/l)	0.384	313.3	0.002*	0.342	343.3	0.001*

RC: Regression coefficient.
* P < .05, Adjusted for the group through the study based on mixed model.

percentage of body fat. Several studies have shown an inverse relationship between measures of body composition, maximal oxygen uptake, and tissue-specific [29–31] and circulating inflammation [32,33]. Attenuated inflammation in the present study is likely related to the marked improvements in VO_{2max} and body composition following participation in aerobic exercise training.

Similar to others [34], our results showed a decrease in enzymatic activities and plasma concentrations of oxidants, while enzymatic activities of radical depleting enzymes such as SOD, CAT and GSH-Px were elevated after exercise training. Our findings are also consistent with the study by Fatouros et al., who emphasize that chronic endurance training may reduce basal and exercise-induced lipid peroxidation and enhance protection against oxidative stress by increasing enzymatic activities of TAC and GPX as well as lowering MDA and 3-nitrotyrosine levels in older men [35]. Together, it appears the exercise protocol used in our study was of high enough intensity to allow for systemic adaptations to the antioxidant defense system, yet low enough not to extremely distress the robust but delicate balance between pro- and antioxidants.

Unbalanced cytokine release has also been reported to be associated with increased ROS production and oxidative stress-related diseases [36]. Consistent with this, increased XO-derived ROS production seems to be responsible for the enhanced expression of mRNA for IL-β and TNF-α [37]. Furthermore, increased AD activity may play a key role in the synthesis of pro-inflammatory cytokines [6]. Therefore, our findings suggest that post exercise decreases in the synthesis of pro-inflammatory cytokines could be attributed, at least in part, to decreased levels of XO and AD activity.

Our results indicate that irregardless of group, changes in inflammation and oxidative stress status were related to the improvements in IBS symptoms. Pro-inflammatory cytokines and pro-oxidants were negatively correlated with IBS symptoms, while significantly positive correlations were observed between IBS symptoms, anti-inflammatory cytokine IL-10 and antioxidant parameters. Therefore, it is probable that participation in moderate intensity aerobic exercise training attenuated IBS symptoms by increasing anti-inflammatory and antioxidant biomarkers as well as suppressing proinflamatory cytokines and oxidants production in previously sedentary IBS patients.

In this study, low-to-moderate intensity aerobic exercise intervention improved IBS severity as demonstrated by significant improvements of the various pain and quality of life scores, and remained significant 60 days post training. Improvement in IBS symptom severity in the EX group were statistically significant starting at week 12 of the intervention and continued throughout the study. Further, over the post intervention period patients in the EX group had continued relief of IBS symptoms, showing durability of response with this exercise protocol. However, we observed markers of inflammation, oxidative stress, antioxidants and IBS symptom severity trending towards baseline eight weeks after training. Therefore, it is possible that a regular regimen of exercise is required to conserve the benefits of exercise training; a conclusion constant with earlier findings demonstrating that the effects of exercise on markers of improved IBS symptoms may gradually subside over time [38,39]. These improvements in EX group imply that physical exercise is useful and should be recommended according to our data. This finding is constant with prior studies that have demonstrated the potential benefits of a physically active lifestyle and regular exercise programs on IBS symptoms and gastrointestinal disorders [38,39]. In the study by Johannesson et al., a 12-week intervention followed by a constant modest increase in physical activity showed long term positive influences on IBS symptoms and some aspects of the disease specific quality of life [38]. The same group showed that physically active patients with IBS would encounter less symptom deterioration than physically inactive patients and suggested the use of physical activity as a primary treatment modality in IBS [39]. While high-intensity training delays gastric emptying [40], previous investigations have revealed that the emptying of liquids and solids in the GI tract seems to be accelerated during either moderate intensity (~28%–65% VO_{2max}) walking or running exercise, compared to resting conditions [40]. Therefore, some of the improvement observed in IBS symptoms in our study may be attributed to the training-induced accelerated bowel transit time [15] that is involved in IBS. More recently, several studies have also indicated that mild physical activity improve abdominal distension [14,41] and reduce symptoms in patients complaining of abdominal bloating [41]. In the present study, abdominal distension severity demonstrated a significant decrease from baseline at 12 and 24 wks in the EX group, findings that may explain the improvement in symptoms shown in this study.

In patients with IBS, there is convincing evidence supporting the notion that the intestinal microbiota is perturbed [42]. Interestingly, it has also been reported that the immune system and host redox status affect gut microbiota [43,44], raising the possibility that dysregulated immune and redox responses might also act on the IBS by intervening a balanced gut microbiota composition. Furthermore exercise has been shown to promote gut microbial diversity and increases health-beneficial gut bacteria populations, leading to a reduction in IBS symptomology [45]. Gut microbiota has also been reported to influence mucosal inflammation [46] and oxidative stress [43] in gastrointestinal diseases. Possibly these effects support the anti-inflammatory and antioxidative effects in the present study, which needs to be addressed in future studies.

Limitations to the current study include, cytokines, pro- and antioxidants measurements were not taken directly from the colonic mucosa to determine correlation with the plasma levels. We further could not carry out the analysis on the subgroup as the number of patients in each IBS subgroup was not sufficient enough. These points are currently being addressed in our laboratory. Strengths of this study included obtaining multiple samples during the course of the study, which enabled us to assess the chronic immune, pro- and antioxidants responses to aerobic exercise training in IBS patients.

In conclusion, aerobic exercise training was effective in enhancing anti-inflammatory and antioxidant biomarkers as well as suppressing proinflamatory cytokines and oxidants production in previously sedentary IBS patients. The adaptations of these markers were associated with improved disease symptomatology in this cohort of IBS patients.

Additionally, the benefits obtained with exercise training may largely be retained after an 8-week detraining period. These findings provide further evidence to support the view that moderate aerobic exercise training may have multiple beneficial effects in patients with IBS. Further studies on the physiologic effects of exercise training on gastrointestinal symptoms to prevent or to treat IBS are needed.

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Chatila et al. BMC Gastroenterology (2017) 17:137
DOI 10.1186/s12876-017-0698-2

BMC Gastroenterology

RESEARCH ARTICLE Open Access

Irritable bowel syndrome: prevalence, risk factors in an adult Lebanese population

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Abstract

Background: Very few studies report on the prevalence of irritable bowel syndrome (IBS) and its correlates in the Middle East. This study investigated Irritable Bowel Syndrome (IBS) prevalence in a sample of Lebanese adult individuals and associated demographic and behavioral lifestyle factors.

Methods: This is an observational population-based study. The target population is working Lebanese adults, eighteen-to-sixty five years old. The sample was selected from a convenience population of bank employees in different geographical areas in Lebanon. The study participants completed an anonymous self-administered questionnaire, to collect data on their socio-demographic, behavioral and life style characteristics, and diagnostic questions following Rome III criteria to assess IBS occurrence. The difference in IBS prevalence by socio-demographic characteristics, smoking, alcohol consumption, and physical activity was assessed by using the Chi-square test. Logistic regression adjusted odds ratios were used to investigate the association between risk factors and IBS.

Results: Data was collected from 553 individuals and consisted of 52.8% females (mean age 35.9 years, SD = 11.9) and 47.2% males (mean age = 36.1 years, SD = 10.3). The prevalence of IBS in the study population according to Rome III criteria was 20.1%. The bivariate analysis indicated that being younger than 30 years old, a female, an ever water pipe smoker, an ever alcohol consumer are significantly associated with a higher prevalence of IBS. Educational level, cigarettes smoking and physical exercise were not significantly associated with IBS occurrence. The logistic regression adjusted odds ratio showed that females were 1.67 times more likely to have IBS than males ($P < 0.05$). The participants aged less than 30 years old were at a higher risk of having IBS ($P < 0.01$). Those who ever smoked waterpipe were 1.63 times more likely to have IBS than those who never smoked waterpipe ($P < 0.05$). Those who were ever alcohol drinkers were twice as likely to have IBS than never-drinkers ($P < 0.01$).

Conclusion: New data on the high prevalence of IBS in an adult population in Lebanon has been reported. This is also the first study to investigate and show an association of waterpipe smoking and IBS. Further longitudinal studies are warranted to determine whether this association is causal.

Keywords: Irritable bowel syndrome, Rome III criteria, Alcohol, Cigarette smoking, Water pipe, Physical activity, Prevalence, Lebanon

Background

Irritable bowel syndrome (IBS) is a functional gastrointestinal disorder characterized by abdominal pain and alterations in bowel habits [1]. The global prevalence of IBS is estimated to be 11.2%, and it is the most common functional gastrointestinal disease. IBS is not a life-threatening condition, yet people with IBS have a reduced quality of life that may affect their educational, social and occupational achievements [2]. The economic burden of IBS is substantial on the healthcare system too. The direct annual cost of diagnosing and treating IBS in the United States is estimated between $1.7 and $10 billion. The indirect costs in terms of absenteeism, workdays lost, disability will double the monetary figure estimated as direct costs [3].

There are several criteria for diagnosing IBS including Rome I, Rome II and Manning criteria, but the most

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widely used method is the Rome III criteria [4]. Thus, the use of different diagnostic criteria will affect the reported IBS prevalence worldwide. Studies using the Rome III criteria, report the prevalence of IBS in Western countries range from 10 to 20% [5]compared with 1 to 10% in the Asian countries [6]. The lowest reported rates were in Southeast Asia (7.0%) while the highest (21.0%) were in South America. The prevalence of IBS varies by socio-demographic factors, gender and age [7, 8]. In developed countries, women are 2-4 times more likely to develop IBS compared to men [7, 9]. IBS is more prevalent among adolescents and declines with age [10].The odds of having IBS are higher among those younger than 50 years compared to those older than 50 years of age [11–13]. Lifestyle factors such as smoking, alcohol consumption [14–16] and physical activity [17, 18] have also been linked to IBS. Moreover, IBS has been associated with psychological factors such as stress and anxiety [6, 8], as well as genetics factors where 33% of patients with IBS report a positive family history [19].

Epidemiologic studies assessing the prevalence of IBS and its correlates are lacking in the developing world and specifically in African and Middle Eastern countries, particularly in Lebanon. Lebanon is a Middle Eastern middle-income country with a population of about four million that experienced a protracted civil war for almost two decades from 1975 to 1990. A recent study among university students in Lebanon reports a prevalence of 20% using the Rome III criteria [17]. Thus, the current study aims to (1) estimate the prevalence of IBS in a Lebanese population based on a sample of employed adults and to (2) assess the behavioral risk factors, including smoking, waterpipe, alcohol use and physical inactivity associated with the disease.

Methods

Study design and recruitment of study participants

This is an observational, population-based study. The target population is Lebanese adults, eighteen-to-sixty five years old. The sample was selected from a convenience population of bank employees in Lebanon. The choice of bank employees was based on the rationale that they represent a significant percent of the private working force. Bank employees also provide a sufficient wide age range of a cohort of working adults in Lebanon. The selected banks were located in major cities across the country: Beirut, the capital, Tripoli and Byblos, in the North, Zahle and Chtaura in the Bekaa, and Saida, Tyre and Nabatieh in the South of Lebanon. All major banks in Beirut were contacted initially by e-mail to request the administration approval to conduct the survey among their employees in the main headquarters in the city of Beirut, as well as branches in other cities. The selected banks were representative of the Lebanese banking sector, as they constituted the major banks in the country. The majority (95%) of the contacted banks agreed to participate.

The data collection extended from January 2016 to April 2016. The employees were informed about the survey by the administration and asked for voluntary participation in the study. The questionnaires were distributed and collected by the study team during working hours (Additional file 1). The consenting participants were asked to return the filled questionnaire in a sealed envelope and deposited in an assigned box for confidentiality. The response rate in different banks varied from 70% to 80%. Bank employees were excluded if they had a history of Crohn's disease, or treated for peptic ulcer diseases. A screening question was used to exclude the non-eligible participants. The research team approached the consenting bank employees and inquired: Have you ever been diagnosed with Crohn's disease? Are you currently taking medication for peptic ulcer disease?. Any respondent who responded yes to any of these two questions was not eligible to participate in the study. All eligible employees in the selected banks completed a fifteen minutes anonymous self-administered questionnaire. The questionnaire included a consent form on its cover page, all participants completing the questionnaire were considered to be indirectly providing their informed consent. The Lebanese American University Institutional Review Board (IRB) committee reviewed and approved the bank request formal letter as well as the study questionnaire.

Data to ascertain prevalence and diagnosis of IBS were based on the Rome III criteria for Functional Gastrointestinal Disorders. IBS is defined as recurrent abdominal pain or discomfort in the last three months for at least 3 days per month, associated with at least two of the following: relief after defecation; changes in bowel movement frequency, and occurrence of symptoms associated with changes in stool form [20]. The questionnaire collected data on socio-economic, demographic and behavioral characteristics (sex, age, education and regional distribution), smoking patterns (cigarettes, waterpipe, cigars and pipe), alcohol consumption physical activity and food intolerance.

Sample size

The sample size calculation based on the probability that the prevalence of IBS is 20% in the population and the error in the estimate of ±3.4% with a 95% confidence interval yielded a required sample size of 532 individuals.

Statistical analysis

The data was analyzed using the Statistical Package for Social Sciences (Version 23.0. IBM Corporation, Arnouk, USA). The association between IBS and socio-demographic characteristics, smoking, alcohol consumption, physical activity and food intolerance was assessed

by Chi-square. Logistic regression was used to predict the independent association of demographic factors, smoking, alcohol consumption, and physical activity on the odds of having IBS. A *p*-value less than 0.05 indicated statistical significance.

Results

The total number of questionnaires collected was 612 but some had to be discarded due to incomplete information on IBS and other characteristics. The final sample size was 553 individuals and consisted of 52.7% females and 47.3% males. The mean age among the females was 35.9 years (SD =11.9) and males 36.1 years (SD =10.3). The majority of the sample had a university degree 65.3%, 17.3% completed higher studies and 17.4% had either secondary education or a technical school degree, (Table 1).

(Table 1 to be inserted here)

Prevalence and bivariate association of IBS by risk factors

The prevalence of IBS in the study population according to Rome III criteria was 20.1%. It varied by socio-demographic and lifestyle factors. The prevalence of IBS was higher among females (22.9%) compared to males (16.9%)(P 0.05). Age was negatively related to IBS, study participants older than 30 years reported less IBS than those younger than 30 years of age. (P 0.01). No significant difference was observed with respect to the educational level of the respondents, (Table 2).

(Table 2 to be inserted here)

Table 1 Distribution of participants by selected characteristics

Characteristics	N	% of Total
Gender		
Male	261	47.2
Female	292	52.8
Age (years)[a]		
18-30	212	40.8
31-40	142	27.4
41-50	109	21.0
50- 65	56	10.8
Bank Location		
Beirut	143	25.9
Bekaa	46	8.3
Mount Lebanon	54	9.8
North Lebanon	126	22.8
South Lebanon	184	26.2
Educational level[a]		
Completed Secondary	67	12.3
Technical School	28	5.1
University Degree	356	65.4
Higher Studies	94	17.2

[a]Totals do not add up to 553 due to missing data

Cigarettes smoking

The prevalence of current cigarette smoking in the total sample was 31.3%, with 12.8% being past smokers, and the remaining 55.9% having never smoked. The prevalence of cigarette smoking was higher (P 0.001) among males (56.3%) compared to females (33.2%). Smoking was more prevalent (P 0.003) among those who had a secondary education or a technical school degree (57.9%) compared to those with a university degree or higher studies 42.4% and 39.4% respectively. No significant difference in IBS prevalence was observed between those who ever smoked and those who never smoked cigarettes, (Table 2).

Waterpipe smoking

The prevalence of current waterpipe smoking was 36.6%, 10.1% were past smokers, while 53.3% never smoked. No sex or educational level differential was noted among waterpipe smokers. Table 2 show that IBS occurred more

Table 2 Distribution of IBS prevalence by respondent characteristics. Irritable Bowel Syndrome

Characteristics	Yes		No			
	N	%	N	%	Total N	P-value
Sex	111	20.1	442	79.9	553	
Male	44	16.9	217	83.1	261	0.046
Female	67	22.9	225	77.1	292	
Education level*						
Secondary/Technical	14	14.7	81	85.3	95	
University Degree	73	20.5	283	79.5	356	
Higher Studies	24	25.5	70	74.5	94	0.182
Cigarettes Smoking						
Never	57	18.4	252	81.6	309	
Ever	54	22.1	190	77.9	244	0.167
Waterpipe Smoking						
Never	49	16.6	246	83.4	295	
Ever	62	24.0	196	76.0	258	0.019
Alcohol Consumption [a]						
Never	55	16.1	286	83.9	341	0.002
Ever	56	26.5	155	73.5	211	
Physical Activity [a]						
Yes	71	19.9	285	79.6	356	0.49
None	40	20.4	156	80.1	196	
Food Intolerance[a]						
Yes	10	35.7	18	64.3	28	
No	101	19.3	422	80.7	523	0.037

[a]Totals do not add up to 553 due to missing data

frequently among ever waterpipe smokers (24.0%) than those who never smoked water pipe (16.6%) (P 0.01).

Alcohol consumption

The prevalence of reported current alcohol consumption was 31.4% with 6.9% being past-drinkers and 61.7% never consumed alcohol. Males reported a greater (P 0.01) alcohol consumption (47.6%) compared to females (34.8%). Alcohol consumption was more prevalent(P 0.0001) among those who had a university or completed higher studies (58.2%) compared to those with secondary education or technical school (38.1%). Table 2 showed that IBS was more prevailing (P 0.001) among alcohol drinkers (26.5%) compared to never alcohol drinkers (16.1%).

Physical activity

The prevalence of physical activity was 63.9%, where 24.4% reported exercising less than once per week, 25.5% exercised 2 to 3 times per week and 14.0% exercised more than 3 times per week. A higher proportion of males (P 0.0001) were physically active (77.9%) compared to females (53.8%), while no difference in activity level was noted between those with different levels of education. There was no change in IBS occurrence by reported physical activity, (Table 2).

Food intolerance

The respondents were also asked to report if they experience any food intolerance. Those who reported experiencing food intolerance ($n = 28$) had a greater (P 0.05) occurrence of IBS (35.7%) compared to those who did not report food intolerance (19.3%).

Logistic regression analysis

Table 3 describes the adjusted odds ratio of IBS correlates and their confidence intervals. The logistic regression showed that the odds of having IBS are 1.69 times higher for females compared to males (P 0.05). A younger age of less than 30 years old, was associated with a higher odds of IBS occurrence 1.80 than those older than 30 years old. Those who ever smoked water pipe were 1.63 times more likely to have IBS than those who never smoked water pipe (P 0.05). Alcohol consumers were twice as likely to have IBS compared to non-alcohol consumers(P 0.05). Physical exercise and cigarette smoking were not significantly associated with having IBS.

(Table 3 to be inserted here)

Table 3 Logistic Regression of IBS occurrence by demographic and life style risk factors

	P-value	Adjusted Odds Ratio	(95% Confidence Interval)
Gender			
Female	0.028	1.691	(1.059-2.699)
Male		1.00	
Waterpipe Smoking			
Ever	0.034	1.630	(1.038-2.599)
Never		1.00	
Physical Activity			
Yes	0.645	0.920	(0.550-1.448)
None		1.00	
Alcohol Consumption			
Ever	0.002	2.064	(1.309-3.254)
Never		1.00	
Age (years)			
≤ than 30	0.011	1.802	(1.147-2.831)
› than 30		1.00	

Discussion

Key findings

This study assessed the prevalence of IBS among a sample of Lebanese employees as well as major lifestyle associations. The prevalence of 20.1% among the sampled adult participants was comparable to two studies of university students, one in Lebanon [17] and a recent one in neighboring Syria [21]as well as estimates reported in developed countries [6]. However the occurrence of IBS was much higher than what has been reported in the West [2]. The reported sex and age differential among those with IBS was consistent with results reported in the literature [7, 8]. Various hypotheses have been proposed to explain the higher prevalence of IBS in females, i.e. higher serotonin synthesis in the brain [22],female sex hormones' effect on gastrointestinal motility [23], and probable association of IBS with an anti-nociceptive mechanism diminishing pain related to pelvic events such as pregnancy and delivery [24].The association of IBS with educational level is inconsistent in the reported literature, where some studies show a higher prevalence of IBS among educated compared to less educated [25–27].Gwee et al. [28] reported that IBS is significantly more prevalent among those with more than 6 years of post-secondary education. Yet, lower education was associated with a higher IBS prevalence in one study [29]. There was minimal variability in the educational level of the participants in our study; therefore such a statistical association could not be analyzed adequately.

Behavioral (lifestyle)risk factors

Individuals who consumed alcohol in our study were twice as likely to suffer from IBS compared to those who did not. The association between alcohol consumption and IBS has been inconsistent in the literature, some studies report no effect [14, 15], while others show that alcohol consumption was associated with a higher IBS

prevalence [16]. Certainly, more studies are required to reach a better understanding of the association between alcohol and IBS.

Our study is the first to investigate the relationship between IBS and waterpipe smoking. Waterpipe smokers were found to have significantly more IBS compared to non-smokers. Waterpipe smoking (Hookah or Shisha) is becoming popular in coffee shops across the Middle East and North Africa and its prevalence in Lebanese youth (13-15 years) has reached 64.5% of males and 54.6% of females; whereas its prevalence in Lebanese adults (18+ years) is about 25.8% for males and 23.3% for females. Unfortunately, Lebanese women have the highest female reported water pipe smoking rate in the region [30]. This social habit seems to have spread to Western countries namely in Europe [31, 32].

Cigarette smoking was significantly more prevalent in males (56.3%) compared to females (33.2%), yet no sex difference was noted in waterpipe smoking. One probable explanation for this difference in sex prevalence seen in cigarette but not waterpipe smoking can be related to the wide social acceptance of waterpipe in the Lebanese culture and the limited knowledge about its risks.

Physical activity has been shown to be an effective measure in relieving gas-related symptoms, and is currently recommended for people who suffer from abdominal bloating as it improves impaired gas clearance related to altered small bowel activity [33].Although Costanian et al. [17], Kim et al. [18] and others [34]have consistently shown higher IBS prevalence in those with low physical activity and that activity improved IBS symptoms, our study showed that physical activity was not significantly associated with IBS occurrence in this adult sample of the Lebanese population.

The role of food intolerance in provoking or exacerbating IBS symptoms have been well described and constitute the basis of the low FODMAP diet [35] . The significant relationship observed in our study of IBS in patient reporting food intolerance, is well established and in agreement with what has been reported in the literature. However, the respondents were not asked what type of food induces the food intolerance, which is a study limitation.

Study limitation

There are several limitations that should be noted in this study. The data was collected through self-administered questionnaires that may lead to a higher percentage of incomplete data than interview surveys. Selection bias is also possible as we limited the study population to bank employees that might already have a better socioeconomic status and educational level compared to the general Lebanese population. This was evident in the finding that 65% of our sample had a university degree compared to 20% in the general population in Lebanon. Moreover, other factors known to be associated with IBS were not addressed, such as depression and anxiety. In addition, the amount of tobacco use, alcohol consumption, and water pipe use was not quantified.

Conclusions

In conclusion, the prevalence of IBS in our sample of employed adults in the banking businesses was high, reaching the upper limit of worldwide prevalence (20%). Given the impact of IBS on the quality of life of those afflicted with the disease, a better understanding of the prevalence and associated socioeconomic and behavioral risk factors among the Lebanese is needed. This is one of the first studies to estimate the prevalence of IBS and its association with lifestyle risk factors (physical activity, waterpipe smoking and alcohol consumption) in an adult subset of the Lebanese population. With respect to waterpipe smoking and its association with IBS, a longitudinal cohort study, controlling for major confounders such a stress is warranted to establish causality of this observed correlation. Future studies would open the door towards an improved understanding of IBS complex GI pathology, and allow a healthier management geared towards the psychological and lifestyle factors related to IBS.

Additional file

Additional file 1: Bloating Questionnaire. (DOCX 98 kb)

Abbreviations

IBS: Irritable bowel syndrome; P: *P*-value; SD: Standard deviation

Acknowledgements

We would like to acknowledge the tremendous help in data collection of Ghassan Daye and Ahmad Naja. Our gratitude is also extended to all the bank employees who participated in the study.

Availability of data and materials

The data set used and analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

RC and MD contributed to the study conception and design; RC, EH, MM, NS, MD contributed to data collection, data analysis and interpretation and writing of the article; MD performed all the statistical analysis; All authors contributed to editing, reviewing and final approval of the article. All authors read and approved the final manuscript.

Ethics approval and consent to participate

The questionnaire included a consent form on its cover page, all participants completing the questionnaire were considered to be indirectly providing their informed consent. The Lebanese American University Institutional Review Board (IRB) committee reviewed and approved the study.

Consent for publication

Not Applicable.

Competing interests
All authors specifically state that "No Competing interests are at stake and there is No Conflict of Interest" with other people or organizations that could inappropriately influence or bias the content of the paper.

Publisher's Note

Received: 19 March 2017 Accepted: 20 November 2017
Published online: 02 December 2017

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Psychology, Health & Medicine, 2016
Vol. 21, No. 2, 176–188, http://dx.doi.org/10.1080/13548506.2015.1051557

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Self-regulation evaluation of therapeutic yoga and walking for patients with irritable bowel syndrome: a pilot study

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(*Received 9 March 2015; accepted 11 May 2015*)

With limited efficacy of medications for symptom relief, non-medication treatments may play an important role in the treatment of irritable bowel syndrome (IBS), the most common functional gastrointestinal (GI) disorder. This study aimed to evaluate the efficacy of two self-regulation strategies for symptom relief and mood management in IBS patients. Thirty-five adult participants meeting ROME III criteria for IBS were enrolled, 27 of the 35 participants (77%) completed treatment and pre- and post-treatment visits (89% women, 11% men; *M* (*SD*) age = 36 (13)), and 20 of the 27 (74%) completed a 6-month follow-up. Participants were randomly assigned to 16 biweekly group sessions of Iyengar yoga or a walking program. Results indicated a significant group by time interaction on negative affect with the walking treatment showing improvement from pre- to post-treatment when compared to yoga ($p < .05$). There was no significant group by time effect on IBS severity. Exploratory analyses of secondary outcomes examined change separately for each treatment condition. From pre- to post-treatment, yoga showed significant decreases in IBS severity measures ($p < .05$), visceral sensitivity ($p < .05$), and severity of somatic symptoms ($p < .05$). Walking showed significant decreases in overall GI symptoms ($p < .05$), negative affect ($p < .05$), and state anxiety ($p < .05$). At 6-month follow-up, overall GI symptoms for walking continued to significantly decline, while for yoga, GI symptoms rebounded toward baseline levels ($p < .05$). When asked about self-regulated home practice at 6 months, significantly more participants in walking than in yoga practiced at least weekly ($p < .05$). In sum, results suggest that yoga and walking as movement-based self-regulatory behavioral treatments have some differential effects but are both beneficial for IBS patients, though maintenance of a self-regulated walking program may be more feasible and therefore more effective long term.

Keywords: self-regulation; Iyengar yoga; walking; irritable bowel syndrome; behavioral treatment

Irritable bowel syndrome (IBS) presents with chronic abdominal pain and irregular bowel habits and is the most common functional gastrointestinal (GI) disorders with prevalence estimates between 10 and 15% in North America (Saito, Schoenfeld, & Locke, 2002). Due to limited efficacy of medications for IBS, lifestyle and behavioral treatments for symptom relief have included exercise, physical activity, and yoga (Daley et al., 2008; Johannesson, Simrén, Strid, Bajor, & Sadik, 2011; Kuttner et al., 2006; Taneja et al., 2004). Results from these studies, though preliminary, have been promising.

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Studies of yoga for IBS have been few, but results have been positive with benefits for pain, symptoms, and mood (Brands, Purperhart, & Deckers-Kocken, 2011; Grundmann & Yoon, 2013; Kuttner et al., 2006; Taneja et al., 2004; Tavassoli, 2009). Iyengar yoga, a systematized form of Hatha yoga utilizing standardized postures and involving strict training of its certified instructors, lends itself well to scientific investigation. In Iyengar yoga, emphasis is placed on awareness and precision of body alignment during postures, often with the aid of props. Iyengar yoga has been tested as a therapeutic treatment with beneficial results for various conditions, including depressed mood and anxiety (Balasubramaniam, Telles, & Doraiswamy, 2013; Javnbakht, Hejazi Kenari, & Ghasemi, 2009; Michalsen et al., 2005; Shapiro & Cline, 2004; Shapiro et al., 2007; Woolery, Myers, Sternlieb, & Zeltzer, 2004), persistent fatigue (Bower, Garet, & Sternlieb, 2011), and pain conditions including low back pain (Williams, Steinberg, & Petronis, 2005; Williams et al., 2005), osteoarthritis (Bukowski, Conway, Glentz, Kurland, & Galantino, 2006; Garfinkel, Schumacher, Husain, Levy, & Reshetar, 1994; Kolasinski et al., 2005), rheumatoid arthritis (Evans et al., 2013), chronic pancreatitis (Sareen, Kumari, Gajebasia, & Gajebasia, 2007), and carpal tunnel syndrome (Garfinkel et al., 1998). Studies of Iyengar yoga for IBS have been favorable, providing a decrease in symptomatology and anxiety (Evans et al., 2014; Kuttner et al., 2006; Taneja et al., 2004). However, the number of studies is small, and none have used an adequate active comparison condition against which to test efficacy of treatment, with most employing a waitlist control.

Walking has also been investigated as a form of physical activity and found to have multiple health benefits, including improved mood (Smith et al., 2010; Song et al., 2013), decreased hypertension, hypercholesterolemia, diabetes, and coronary heart disease (Williams & Thompson, 2013), and decreased mortality (Hakim et al., 1998; Paffenbarger, Hyde, Wing, & Hsieh, 1986). In a review of studies comparing yoga with exercise, which at times included walking, Ross and Thomas (2010) found that yoga was effective, and at times more effective, than exercise at improving a variety of outcomes. No studies have compared Iyengar yoga with non-strenuous walking in IBS patients.

To maintain the beneficial somatic and psychological effects of any therapeutic exercise program, including walking and yoga, establishing, implementing, and maintaining these practices in an individual's routine is critical. It is therefore appropriate to view and evaluate these treatments as self-regulation strategies. According to the social cognitive theory of self-regulation, one's future actions are based in current forethought and motivation (Bandura, 1991). In practicing self-regulation, attention is focused on self-generated goals, motivation is developed toward those goals, self-monitoring is employed to heighten awareness of thoughts and moods on patterns of behavior, and over time and with the development of self-efficacy, standards are set which help guide consistency in future behavior. A successful self-regulation strategy results in adherence to behavioral changes such that they become part of an individual's routine practices. Therefore, evaluating the efficacy of self-regulation treatments should include measures of beliefs about and adherence to regular practice following initial training in behavioral change.

This study examined yoga and walking as self-regulation strategies for improving IBS. Prior studies have mostly tested complementary medicine treatments against wait-list or no-treatment conditions. The use of an active and common self-regulation strategy like walking as a comparison allows for testing the benefit of a specific yoga treatment vs. more general self-regulation. This study included an assessment of

symptom change at the end of the treatment as well as variables related to beliefs about and actual practice of yoga and walking in the 6 months following initial treatment. The aims of this pilot comparative trial were to (a) evaluate the differential impact of yoga vs. walking on IBS symptoms and mood and (b) evaluate the influence of post-treatment practice on longer term outcomes.

Method

Participants

Participants included 18- to 65-year-old men and women who reported their primary medical complaint as chronic abdominal pain or discomfort and associated bowel habit changes consistent with ROME III criteria for IBS (Longstreth et al., 2006). Participants were recruited from flyers in the community, internet announcements, and referrals from UCLA and local physicians. All participants were physically able to engage in an exercise program, consumed less than two drinks of alcohol per day, and were not practicing yoga more than once per week upon starting treatment. For the few cases of participants who were practicing yoga at study enrollment, none were doing Iyengar yoga nor regularly attending classes, and most practiced only once per week or less. During the course of treatment, only Iyengar yoga poses were performed as home practice. Participants with major psychiatric disorders, such as schizophrenia or bipolar disorder, were excluded but not those with mild-to-moderate anxiety or depression symptoms or on psychotropic medications, if on a consistent dose for 3 months. Informed consent was signed by all eligible participants prior to enrollment, and the institutional review board at UCLA approved the protocol.

A total of 35 participants were enrolled and randomly assigned to either the therapeutic yoga or walking conditions. Of the 35 participants who were enrolled, 8 dropped out of treatment, 5 from yoga and 3 from walking. Dropout rates for both conditions were 23%. Reasons for withdrawal were traffic, difficulties in getting to sessions, and changes in schedule. Twenty-seven participants completed the treatment and returned for the post-treatment assessment. Of these, 17 were assigned to yoga and 10 to walking.

Procedure

Participants enrolled in yoga attended up to 16 group sessions of yoga offered on a biweekly basis, led by an Iyengar Yoga certified instructor. Yoga sessions lasted approximately 60 min. At each session, participants alternated between practicing two sequences of Iyengar yoga postures. Postures were first demonstrated by the instructor who also discussed the health benefits of each posture. Participants were also encouraged to practice select postures at home between sessions. Pictures of the poses were provided to help with home practice, and instructors discussed ways of facilitating home practice (e.g., use of couch cushion as a bolster). Sequences and home practice postures, listed in Table 1, consisted of seated poses, inversions, backbends, twists, and restorative supine poses. Postures were selected because they are believed to be therapeutic for abdominal symptoms associated with IBS. Senior Iyengar yoga instructors were consulted to select postures, and sequences were approved by Mr Iyengar, the founder of the Iyengar School of yoga, in India. Because Iyengar yoga emphasizes alignment, props including bolsters, chairs, belts, and blocks were used to help participants achieve the postures.

Table 1. Sequence of poses for yoga treatment.

Sequence 1	*Sequence 2*	*Home practice*
Supta Virasana	Baddhakonasana	Supta Virasana
Supta Baddhakonasana	Upavista Konasana	Supta Baddhakonasana
Dvi Pada Viparita Dandasana	Adhomukha Svanasana	Matsyasana
Sarvangasana	Adhomukha Virasana	Sarvangasana
Halasana	Salamba Sirsasana	Half Halasana
Viparita Karani	Adhomukha Virasana	Setubandha Sarvangasana
Setubandha Sarvangasana	Supta Virasana	Viparita Karani
Setubandha Sarvangasana [legs in Baddhakonasana]	Salamba Sarvangasana	
Salamba Savasana	Ardha Halasana	
	Parsva Halasana	
	Parsva Pindasana	
	Savasana	

Participants enrolled in walking participated in up to 16 group sessions of non-aerobic, moderate paced, outdoor walking led by physical trainers who set the pace and led discussion during each session. Walking sessions were offered on a biweekly basis and lasted about 60 min. Discussion during each walking session focused on health benefits of walking and physical activity.

Measures

Primary outcomes assessed before and after treatment and at 6-month follow-up included two IBS severity measures and a measure of negative affect. Secondary outcomes included a measure of symptom-specific anxiety, general anxiety, and severity of somatic symptoms. All participants were asked about their expectations of benefit from each treatment before random assignment to yoga or walking. At post-treatment and 6-month follow-up, they were asked about their expectation of continuing to practice yoga or walking on their own and how often, on average, they did yoga or walking over the past month.

Overall GI and abdominal pain severity

Two IBS severity measures were used, both scored on a 21-point numerical rating scale (NRS) with higher scores signifying greater severity. Participants rated severity of overall GI symptoms and of abdominal pain during the past week, from no symptoms to the most intense imaginable. Validity of NRS scales for IBS severity has previously been established (Spiegel et al., 2009).

Positive and negative affect schedule

The positive and negative affect schedule (PANAS-X) is a well-established 60-item scale measuring an individual's current feelings and emotions (Watson & Clark, 1999). The negative affect scale (mean score) was used to represent global changes in negative mood. Responses on the PANAS-X range on a 5-point scale with higher sum-scores signifying greater negative affect. Internal consistency for the negative affect subscale of the PANAS-X has been reported as above .85 (Watson & Clark, 1999).

Visceral sensitivity index

The visceral sensitivity index (VSI) is a validated 15-item scale measuring GI symptom-specific anxiety (Labus et al., 2004). Responses on the VSI items range on a 6-point scale with all items reverse coded and summed for a total score. Higher scores signify greater GI symptom-specific anxiety. Internal consistency of the VSI has been reported as .93 (Labus et al., 2004).

Patient health questionnaire-15

The patient health questionnaire-15 (PHQ-15) is a 15-item scale of severity of somatic symptoms (Kroenke, Spitzer, & Williams, 2002). Responses on the PHQ-15 use a 3-point scale with all items summed for a total score. Higher scores signify greater somatic symptoms. Internal consistency of the PHQ-15 has been reported as .80 (Kroenke et al., 2002).

Spielberger state anxiety inventory

The Spielberger state anxiety inventory (STAI) is a 20-item scale measuring state anxiety on a 4-point scale with higher scores signifying greater state anxiety (Spielberger & Sydeman, 1994). Internal consistency for the STAI has ranged from .86 to .95 and test-retest reliability from .65 to .75 (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983).

Data analyses

The study sample was characterized on a variety of demographic factors, lifestyle factors, and predominant bowel habits. Repeated measures analysis of variance was used to examine the main effect of treatment condition and interactions of group assignment by time on primary outcome measures. Exploratory analyses to look for differential impact of the treatments on the primary and secondary outcomes utilized paired t-tests to examine magnitude of change within each treatment condition. Similar repeated measures analyses and paired t-tests were used to examine the maintenance of treatment effects from post-treatment to 6-month follow-up. Chi-square statistic was used to examine differences in home practice between treatment conditions. All analyses were performed using IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp, Released 2013, Armonk, NY).

Results

Sample descriptives

Descriptive statistics for the total sample as well as by treatment condition are presented in Table 2. The overall sample included 27 adults, of whom 17 (63.0%) were randomly assigned to yoga and 10 (37.0%) to walking. All participants were offered 16 sessions of treatment, and the average number of sessions completed in both yoga ($M = 14.2$, $SD = 2.0$) and walking ($M = 13.8$, $SD = 3.1$) was similar. The study originally aimed for 25 participants in each treatment condition, but due to difficulties with recruitment, the study was halted at 35 enrolled participants, resulting in uneven group sizes. The sample included equal numbers of those with constipation as their primary bowel habit and those with diarrhea as primary. At baseline, the yoga and walking conditions did not

Table 2. Descriptive statistics for total sample and by treatment condition.

Variable	Total ($n = 27$)	Yoga ($n = 17$)	Walking ($n = 10$)
Age [y, *M* (*SD*)]	36.3 (12.8)	34.7 (11.6)	39.0 (15.0)
BMI [*M* (*SD*)]	24.6 (4.6)	24.0 (4.2)	25.7 (5.3)
Gender (%)			
Men	11.1	11.8	10.0
Women	88.9	88.2	90.0
Education (%)			
≤High school diploma	3.7	0	10.0
Some college	22.2	17.6	30.0
College degree	33.3	41.2	20.0
Graduate school	40.7	41.2	40.0
Marital status (%)			
Single	48.2	52.9	40.0
Married	40.7	41.2	40.0
Separated/divorced	7.4	5.9	10.0
Widowed	3.7	0	10.0
Menopausal status (%, women only)			
Pre	70.8	73.3	66.7
Peri	16.7	26.7	0
Post	12.5	0	33.3
Smoking status (%)			
Non-smoker	96.3	94.1	100
Current smoker	3.7	5.9	0
Currently exercise (%)			
Yes	44.4	41.2	50.0
No	55.6	58.8	50.0
Bowel habits (%)			
Constipation	44.4	41.2	50.0
Diarrhea	44.4	47.1	40.0
Unspecified	7.4	11.8	0
Mixed	3.7	0	10.0
Expect more benefit from (%)			
Yoga	88.0	93.7	77.8
Walking	12.0	6.3	22.2

Notes: y = year, *M* = mean, *SD* = standard deviation of the mean.

differ significantly on demographic factors, including age and BMI, or main outcome variables including severity of abdominal pain or GI symptoms. Participants were asked about expectations of treatment preceding random assignment to treatment. The vast majority in both yoga and walking reported a preference for and a greater belief in the benefit of yoga, as seen in Table 2. Statistics for the outcome measures at pre- and post-treatment are presented in Table 3.

Treatment effects on primary outcomes

As shown in Figure 1, a repeated measures analysis revealed a significant main effect for time (pre- to post-treatment) on abdominal pain severity during the past week ($F(1, 25) = 9.40$, $p < .01$), with abdominal pain decreasing from pre- ($M = 10.6$, $SD = 4.2$) to post-treatment ($M = 7.2$, $SD = 4.1$). The main effect for group (yoga vs. walking) was not significant ($F(1, 25) = 0.12$, $p = .74$) nor was the interaction of group assignment by time ($F(1, 25) = 2.55$, $p = .12$). A repeated measures analysis revealed a significant main

Table 3. Outcome measures by treatment condition at pre- and post-treatment.

	Yoga ($n = 17$)		Walking ($n = 10$)	
Outcome [*M* (*SD*)]	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Overall GI symptom severity	11.5 (4.3)	8.2 (4.8)	11.2 (4.5)	6.2 (2.5)
Abdominal pain severity	11.2 (3.9)	8.1 (4.2)	9.7 (4.7)	5.8 (3.8)
Visceral sensitivity	44.2 (19.3)	39.1 (19.6)	35.0 (14.1)	31.8 (19.1)
Somatic symptoms severity	14.7 (5.7)	12.1 (6.4)	12.4 (3.7)	11.1 (3.2)
Negative affect	16.1 (7.0)	16.5 (7.2)	15.3 (4.8)	11.8 (2.2)
State anxiety	54.5 (10.6)	53.9 (10.9)	53.7 (9.6)	49.3 (5.4)

Notes: *M* = mean, *SD* = standard deviation of the mean.

effect for time on overall GI symptoms during the past week ($F(1, 25) = 12.88$, $p = .001$), such that overall GI symptoms dropped from pre- ($M = 11.4$, $SD = 4.3$) to post-treatment ($M = 7.5$, $SD = 4.1$). In this model, the main effect for group was not significant ($F(1, 25) = 0.85$, $p = .36$), nor was the interaction of group by time ($F(1, 25) = 0.59$, $p = .45$).

A similar analysis for negative affect found no main effect for time ($F(1, 25) = 3.41$, $p = .08$), nor group ($F(1, 25) = 1.49$, $p = .23$), but did reveal a significant interaction of group by time ($F(1, 25) = 5.47$, $p < .05$). As shown in Figure 2, mean scores of negative affect for yoga stayed stable from pre- ($M = 16.1$, $SD = 7.0$) to post-treatment ($M = 16.5$, $SD = 7.2$), whereas for walking, mean scores of negative affect significantly dropped from pre- ($M = 15.3$, $SD = 4.8$) to post-treatment ($M = 11.8$, $SD = 2.2$).

Exploratory analysis of within group treatment effects

Secondary analyses were performed to examine the differences from pre- to post-treatment within treatment condition. For yoga, significant differences in abdominal pain ($t(16) = 2.84$, $p < .05$), overall GI symptoms ($t(16) = 2.57$, $p < .05$), visceral sensitivity ($t(16) = 2.44$, $p < .05$), and severity of somatic symptoms ($t(16) = 2.52$, $p < .05$) were observed from pre- to post-treatment. For walking, significant differences in overall GI symptoms ($t(9) = 2.38$, $p < .05$), negative affect ($t(9) = 2.65$, $p < .05$), and state anxiety ($t(8) = 2.34$, $p < .05$) were observed. To illustrate these different group effects on the various outcomes, Figure 3 shows these results in terms of percent change from pre- to post-treatment.

Maintenance of effects at 6-month follow-up

Of the 27 participants who completed treatment, 20 completed 6-month follow-up questionnaires assessing IBS severity, mood, and continued practice of yoga or walking. Of these, 12 (60%) were from the yoga condition and 8 (40%) from the walking condition. Data collection rates at 6-month follow-up for yoga and walking were similar (80 and 67%, respectively). For severity of abdominal pain during the past week, there were no significant main effects for time ($F(1, 18) = .50$, $p = .49$) or group ($F(1, 18) = .09$, $p = .77$), nor a significant group by time interaction ($F(1, 18) = .01$, $p = .91$). For overall GI symptoms during the past week, there were no main effects for time ($F(1, 17) = .65$, $p = .43$) or group ($F(1, 17) = 3.88$, $p = .07$); however, there was a significant group by time interaction ($F(1, 17) = 7.15$, $p < .05$). Specifically, mean of overall GI symptoms

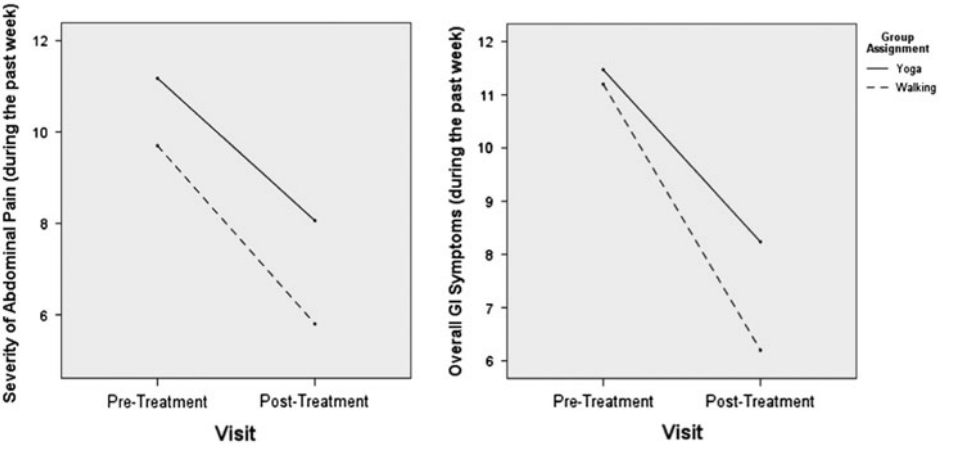


Figure 1. Changes in IBS severity from pre- to post-treatment by treatment condition.

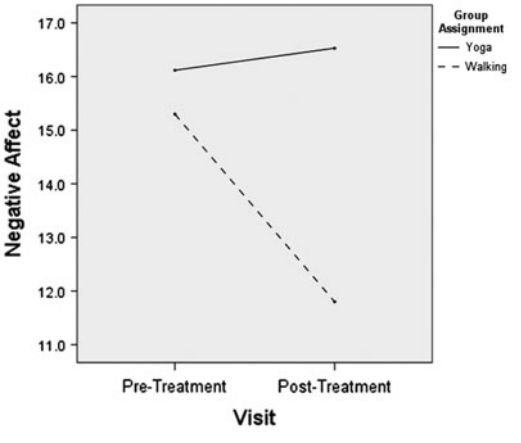
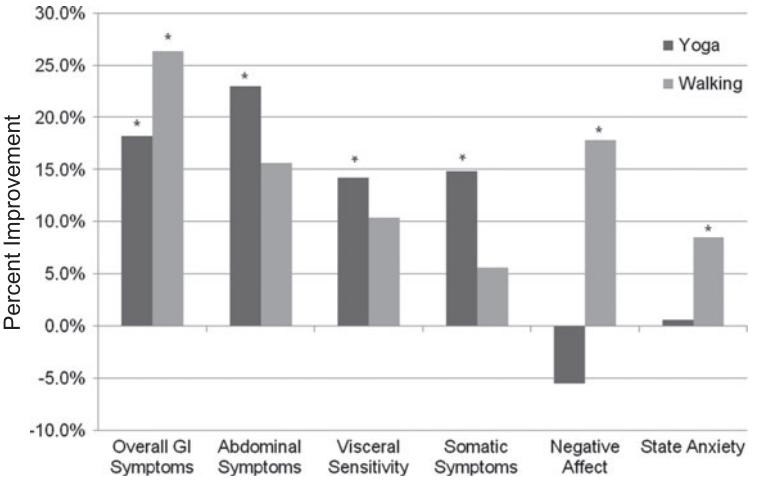


Figure 2. Changes in negative affect from pre- to post-treatment by treatment condition.

for yoga rose from post-treatment ($M = 6.9$, $SD = 4.2$) to 6-month follow-up ($M = 9.3$, $SD = 4.0$), whereas for walking, mean of overall GI symptoms continued to drop from post-treatment ($M = 6.4$, $SD = 2.7$) to 6 months ($M = 4.1$, $SD = 1.6$). Follow-up analyses of negative affect found no main effects for time ($F(1, 18) = .50$, $p = .49$), group ($F(1, 18) = 2.05$, $p = .17$), or the interaction of group by time ($F(1, 18) = 1.65$, $p = .22$).

Home practice

Participants were asked how much, on average, they practiced their assigned treatment condition at home. No significant difference was found between number of participants who did weekly home yoga ($n = 8$) and number of participants who did weekly home walking ($n = 7$) while participating in treatment ($\chi^2(1, N = 26) = 1.01$, $p = .32$). After completion of treatment, participants were encouraged to continue with regular home



*$p < .05$.

Figure 3. Percent improvement from pre- to post-treatment within treatment condition.

practice of yoga or walking. At 6-month follow-up, assessment was made regarding home practice. Eighty-eight percent of yoga participants reported they planned on doing yoga at home after treatment completion, while 90% of walking participants reported they planned on walking on their own. At 6-month follow-up, 50% of participants assigned to yoga reported they had practiced yoga at least once in the last month, whereas 100% of those assigned to walking reported walking at least once in the last month, as shown in Figure 4. The number of participants who reported regular home practice at least once a week or more at 6 months was significantly greater for those in walking (75%) than in yoga (25%) ($\chi^2(1, N = 20) = 4.85$, $p < .05$). At 6 months, when asked if they planned on continuing home practice, 42% assigned to yoga reported yes, and 80% assigned to walking reported yes.

Discussion

The primary purpose of this study was to examine the differential efficacy of two self-regulation strategies, therapeutic yoga and walking, for symptom relief and mood management in IBS patients. As well, this study examined beliefs about and maintenance of these effects following treatment completion.

Support was found for greater improvement in negative affect from a 16-week walking program compared to therapeutic yoga. However, results did not show a significant treatment condition by time interaction on IBS symptoms. Secondary analyses suggest there may be some differential effects of each treatment. From pre- to post-treatment, yoga significantly decreased both measures of IBS symptom severity, somatic complaints, and visceral sensitivity, while walking significantly improved mood and decreased overall GI symptoms. These findings differ somewhat from prior studies comparing these two treatments, which have found greater symptom benefit from yoga when compared with non-aerobic walking (Oken et al., 2006; Ross & Thomas, 2010); however, none of the prior studies examined differences in IBS patients. Similar to a prior study that found a walking and stretching treatment improved psychological symptoms

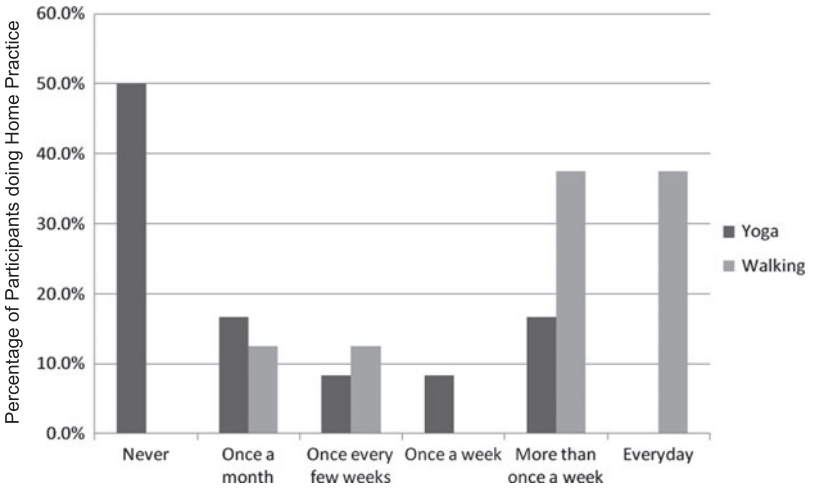


Figure 4. Home practice at 6-month follow-up.

in menopausal women (Chattha, Raghuram, Venkatram, & Hongasandra, 2008), our study did show a drop in negative affect and anxiety for the walking condition.

At 6-month follow-up, results supported the continued efficacy of walking by demonstrating a significant decline in overall GI symptoms. Consistent with these results was the finding that the walking condition reported significantly more self-regulated home practice when compared to yoga. This finding supports the social cognitive model of self-regulation by providing evidence that those who were motivated and able to maintain behavioral changes, in this case with continued home practice of walking after completion of treatment, also demonstrated longer term effects on symptoms. It is also interesting to note that about 90% of subjects, pre-randomization, had higher expectations of benefit for yoga over walking. This adds support to the positive impact of walking practice which produced significant benefit and better adherence despite low initial expectations.

There are a few noteworthy limitations to this study. First, the study sample was small, and therefore, the results need replication in larger samples. Second, walking is an active control, therefore, efficacy of yoga as a treatment for IBS, as compared to a wait-list or no-treatment control condition as shown in other studies, could not be directly tested. A strength of the current design, however, is that differential impacts of two active and salient self-regulation treatments could be tested, and specific benefits of yoga designed for IBS are elucidated. Third, the sequence of yoga postures for IBS utilized in this study, as designed by our Iyengar yoga experts, did involve props and may have been more difficult to implement at home, especially after completion of treatment; therefore, future studies of yoga may benefit by selecting postures that are less prop dependent and more conducive to home practice. Fourth, although discussion during both the yoga and walking conditions were primarily led by the group leaders, it is possible that the somewhat decreased structure of the walking group resulted in a differential impact of social support across treatment condition. Fifth, though treatment attendance and home practice were monitored, treatment fidelity was not assessed in depth (e.g., daily amounts of walking done by yoga group and yoga done by walking group). Considering these limitations, further studies of yoga with appropriate

comparison treatments, longer term outcomes, and examination of individual difference moderators of response will be necessary to confirm and expand upon these findings.

Despite its limitations, the implications of this study are important. Though no interaction effect of treatment condition by time on IBS symptoms was seen from pre- to post-treatment, secondary analyses showed yoga having a more significant impact on specific symptoms and walking having a more significant impact on mood. Likely due to a larger percentage of participants maintaining regular home practice, at 6-month follow-up, walking appeared to be more beneficial for GI symptom relief. Understanding self-regulation strategies and their impact on longer term effects is important when designing feasible and effective treatment studies. Assessment of beliefs about behavioral treatments, motivating factors, and behavior change taking place during and after implementation of interventions can help us better understand why some participants continue self-regulatory practices and why others stop. It will also help us better comprehend which treatments are most effective and what the barriers are to continuation of treatments after intervention is complete.

Acknowledgements

The authors thank the Oppenheimer Center for Neurobiology of Stress, Paul Cabanis and our yoga instructors, Joel Andres and our physical trainers, Suzanne Smith, Pablo Woodward, our UCLA undergraduate research assistants, and the Iyengar Yoga Institute of Los Angeles.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the Gail and Gerald Oppenheimer Family Foundation and the Marcled Foundation.

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Journal of the Egyptian Public Health Association

RESEARCH Open Access

Factors associated with irritable bowel syndrome among medical students at Ain Shams University

Doaa Elhosseiny[1], Nehal Elfawy Mahmoud[2*] and Ayat F. Manzour[1]

Abstract

Background: Irritable bowel syndrome (IBS) is one of the most common and potentially disabling gastrointestinal disorders. The pathogenesis of this disorder remains obscure. However, many etiological explanations point toward bacterial etiology. Also, several studies have documented that psychological and social factors may play a role. Medical education is among the most challenging and stressful education, and this may predispose to high rates of IBS.

Objectives: The aims of this study are to estimate the frequency of IBS in a selected sample of students of Faculty of Medicine in Ain Shams University and to find out the determinants associated with this disorder.

Study design: A cross-sectional study was carried out among medical students from October 2017 to February 2018 at Faculty of Medicine—Ain Shams University. All participants were asked to complete a confidential self-administered questionnaire. An interview questionnaire was used for diagnosis of IBS according to Rome III criteria, while morbid anxiety and depression were diagnosed by using the Arabic version of Hospital Anxiety and Depression Scale (HADS).

Results: Three hundred eighty-two students completed the questionnaire. The frequency of IBS was 31.7% with higher proportion among females and among students with positive family history of IBS. However, IBS was significantly less prevalent among students practicing regular exercise. Lastly, based on (HADS), there was a statistical significant relationship between IBS and anxiety ($p < 0.05$), but not depression.

Conclusion: The study revealed that around 31% of the studied group was suffering from IBS. Female gender, suffering from anxiety, and positive family history of IBS were the main associated factors for IBS. Screening of all medical students in the faculty for IBS is suggested. Providing psychological and emotional support along with stress management is highly recommended.

Keywords: Irritable bowel syndrome, Medical students, Hospital Anxiety and Depression Scale, Stress-related diseases, Anxiety

1 Introduction

Irritable bowel syndrome (IBS) is one of the most common and potentially disabling gastrointestinal disorders characterized by pain in abdomen, bloating, and alteration in a person's bowel habits, but without any organic pathology [1]. Traditionally, in practical work, IBS was diagnosed by exclusion, but recently, Rome criteria was used as a golden tool for diagnosis of IBS in researches and clinical work. According to Rome III, three types of IBS have been recognized; (1) diarrhea-predominant, (2) constipation-predominant, and (3) alternating diarrhea and constipation [2]. The prevalence of IBS varies from 5.7 to 34% worldwide, with a wide variation based on the tool used [3]. According to Rome III criteria, Western population have higher prevalence of IBS (ranges from 10 to 15%) than Asian ones (ranges from 1 to 10%) [4]. Arab countries are among the least studied populations in the world. A recent meta-analysis of the global prevalence of IBS revealed no studies done from any Arab country [3]. However, limited data are available on IBS in some countries, including an Egyptian study conducted in an urban area in Suez governorate which revealed high prevalence rate of

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34.2% among the studied group [5]. Another study conducted in Saudi Arabia showed a prevalence of 11.4% [6].

The burden of this disorder on healthcare systems is major. In the USA, it was reported that 8 billion dollars were spent annually on medical cost of IBS patients. In addition, many patients underwent unnecessary surgeries such as appendectomy or hysterectomy due to difficulty in diagnosis in some atypical cases [7].

Also, the quality of life for patients suffering from IBS is greatly affected physically, psychologically, and economically. Several cases reported difficulties in concentration, decreased energy level, and lower self-esteem [8]. IBS has also induced an occupational hazard as it affects the performance of patients at their jobs. An interesting Iranian study reported that IBS was the second leading cause of lost work days after common cold [9]. In addition, many cases become socially embarrassed due to unpredictable bowel habits [10].

Although half of the cases referred to gastroenterologists is due to IBS, no clear etiology was found; however, some researches revealed that certain factors such as psychological factors, dietary habits, and exercise level were related to IBS onset and course [10]. There might be also a genetic role in the etiology of IBS as 33% of patients reported a positive family history [11]. Moreover, personal factors including age and gender might influence the occurrence of IBS. It has been reported that females are more vulnerable than males and those in their late teens and twenties have the highest risk [11].

Anxiety and depression can affect many university students particularly those studying medicine. They are under constant stress due to the long duration of their study with high work overload and mental exhaustion due to numerous exams [12, 13]. A recent Chinese study compared the prevalence of IBS among students in different universities and found that medical students had the highest level of IBS compared to engineering and science students [14]. In Saudi Arabia, a study conducted on medical students and interns in Jeddah reported a prevalence of IBS of 31.8% [15]. In Egypt, information on the prevalence of IBS and its associated factors among university students is deficient; a recent study reported 22.9% prevalence rate among Suez Canal University students [16]. To our knowledge, there is a lack of studies regarding the epidemiology of IBS among Egyptian medical students.

The aims of this study are as follows:

1. To measure the frequency of IBS and its subtypes in a sample of medical students based on Rome III criteria.
2. To identify associated factors related to IBS (socio-demographic, some life-style habits, dietary habits).
3. To investigate the relation between IBS and emotional disturbance as regards morbid anxiety and depression among the study group.

2 Participants and methods

2.1 Study design

Analytical cross-sectional study was conducted in 4 months duration from October 2017 to February 2018.

2.2 Study setting

This study was carried out at the Faculty of Medicine, Ain Shams University, located in El-Abassyia, Cairo, Egypt.

2.3 Participants and sample size

Medical students studying at the Faculty of Medicine in the academic year (2017–2018) from the first to the sixth educational years with their age ranges from 18 to 25 years were included in the study. Participants with known organic gastrointestinal disorders or individuals with alarming symptoms like marked weight loss and bloody stools were excluded.

2.3.1 Study sample

Sample size was calculated using Open-epi; an open source software for epidemiological statistics, assuming hypothesized percentage of IBS in the population = 31.8% on the basis of a previous study [15] and 95% confidence limits. The minimum calculated sample size to achieve study objectives was 334. Sample size was increased to 400 students to compensate for non-response. Proportionate stratified random sampling was used to allocate participants based on percentage of students in each academic year. Response rate was 95.5% (382). Reasons for non-participation were lack of time and refusals.

2.4 Tools of the study

A validated pre-constructed anonymous questionnaire was used. The questionnaire composed of four parts:

2.4.1 First tool

A self-administered questionnaire was used to collect baseline information such as socio-demographic and academic data; family history of IBS; previous diagnosis of IBS by a physician; other chronic medical conditions; daily life habits such as number of sleeping hours, smoking, exercise, and so on; Traveler's diarrhea and whether its presence triggered the first onset of IBS; and negative life events during childhood such as death of a close family member, parents' divorce, or experiencing serious illness. Regular exercise was defined as practicing any type of sport for 30 min three times per week. Those who smoked greater than 100 cigarettes in their lifetime and has smoked in the last 28 days were considered as

current smokers. Enough income was defined as income more than 3600 Egyptian pounds [17]. Travelers' diarrhea was defined as suffering from abrupt onset of diarrhea that might be associated with fever, bloating, and loss of appetite during the trip.

2.4.2 Second tool

Food Frequency Questionnaire (FFQ) was self-administered and was used for dietary assessment inquiring about frequency of use of different food items such as milk, yogurt, fruit and vegetables, fish, fast food, homemade food, and so on. The FFQ is widely used for dietary assessment in epidemiologic research. The collected data was used to calculate nutrient intake and to relate consumption of foods to specific disease outcomes [18].

2.4.3 Third tool

The English version of Rome III questionnaire was used for IBS diagnosis [2] The Rome III criteria is a standard tool used widely in the diagnosis of functional gastrointestinal disorders. Rome III Criteria can rationally diagnose IBS in the absence of red flag symptoms. The sensitivity of Rome III Criteria is 65%, specificity is 100%, and the positive predictive value is 100% [2, 19]. Students were interviewed by an expert for accurate diagnosis of cases. IBS was defined according to Rome III criteria as recurrent abdominal pain for at least 3 days per month during the past 3 months, associated with two or more of the following features: (1) improvement with defecation; and/or (2) onset associated with a change in stool frequency; and/or (3) onset associated with a change in stool appearance. Individuals with IBS were divided into (1) diarrhea-predominant, (2) constipation-predominant, and (3) alternating diarrhea and constipation according to the proportion of lumpy and hard stools. Reliability was assessed with Cronbach's α by the researches and was found to be 0.75.

2.4.4 Fourth tool

The Arabic version of Hospital Anxiety and Depression Scale (HADS) [20] was self-administered and was used to identify individuals with clinically significant symptoms of anxiety and depression. It is a standardized, valid, and reliable self-report rating scale. It has 14 questions; seven questions for anxiety and seven for depression, for the answers, four-point Likert scale is used ranging from 0 (not present) to 3 (considerable). In addition, anxiety and depression scores are summed separately. For each subscale, the scores can be divided into 0–7 (normal), 8–10 (borderline), and over 11 (cases). Reliability was assessed with Cronbach's α and was found to be 0.82.

A pilot study was conducted prior to data collection on ten participants to test clarity and applicability of the questionnaires, and necessary modifications were done in some questions.

2.5 Ethical consideration

Ethical approval was obtained from ethical committee, Faculty of Medicine, Ain Shams University. An informed written consent was obtained from all the students after informing them about the aim of the study and assuring the confidentiality of all provided data and that no personal identifying data would be used in the study.

2.6 Data management and statistical analysis

All eligible questionnaires were coded. Data analysis was performed using the SPSS 20.0 (SPSS Inc., Chicago, IL). Distributions of sex and lifestyle factors were analyzed by Pearson's χ^2. BMI = kg/m^2 where kg is a person's weight in kilograms and m^2 is their height in meters squared. BMI was categorized as follows: underweight (< 18.5), normal weight (18.5–24.9), overweight (25–29.9), while obesity is considered when BMI is 30 or greater. Student t test was used to compare the anxiety and depression levels between groups. Quantitative data were presented as mean ± SD. All calculated p values were two-tailed and $p < 0.05$ was considered statistically significant. Multivariate logistic regression was utilized to find out factors associated with IBS.

3 Results

This cross-sectional study included 400 medical students; 382 completed the questionnaire. Rome III criteria questionnaire was used to diagnose IBS. It was found that 121 students were positive giving an IBS frequency of 31.7% among studied medical students. Examining subtypes of IBS revealed that 26.6% were diarrhea predominant (IBS-D) while 73.4% were constipation predominant (IBS-C).

The Majority of studied sample were males (66.5%), 53.1% were in junior years (1st, 2nd, and 3rd years), while 46.9% were in senior years. Their mean age was 20.69 ± 3.99. Only 4.5% of study sample's grade point average (GPA) was excellent while 32.5% had accepted and 45.8% had good/very good assessment in previous years. Seven percent only were married while the rest were single. Almost half (54.8%) their parents had enough monthly income or even exceeds their needs. Overweight/obese students comprised 31.9, 1.3% were underweight, while 65.8 were within normal BMI. Further, 8.5% were smokers, 37% performed regular exercise,53.3% used to drink eight water cups or more daily, only 24.5% used to have breakfast every day while half (50.2%) used to drink fluids along with having their meals. Analyzing HADS indicated that 32.9% have morbid anxiety, 26.1% had depression, and 26.3% were borderline for

anxiety while 27.2% were borderline for depression. Regarding family history of IBS, 35.8% of students had positive family history while 14.3% have different chronic diseases. Traveler's diarrhea was reported in 8%, food allergy in 14.8%, while 16.8% were previously diagnosed as IBS patients. Almost two-thirds of participants (68.5%) had sources of emotional stress in the past 6 months. Food frequency questionnaire analysis revealed that almost two-thirds of students eat vegetables (66.8%), fruits (66.9%), milk, and dairy products as well as eggs (64%) and home-made food (69.8%) three or more times weekly. Most of participants eat fish (89.2%) and nuts (87.6%) twice or less weekly. High-fat diet and fast food were eaten three times or more weekly in 30.8% and 39.7% respectively. Regarding caffeine drinking, 52.6% used to drink coffee and 63.6% used to drink tea three or more times every week. Around half of studied sample eat fried food and processed food on weekly basis (three times or more) (49% and 45.6% respectively). One-third used to eat spicy food frequently (three times or more) (35%) while most of them use artificial sweeteners twice/week or less.

Table 1 shows that there was a statistically significant differences between IBS students and free students regarding sex ($p = 0.006$), academic stage ($p = 0.04$), and family history of IBS ($p = 0.012$). No statistically significant differences regarding other socio-demographic characteristics were detected.

Table 2 shows that there was a statistically significant difference regarding regular exercise performance between IBS students and normal students ($p = 0.007$). No statistically significant differences regarding other lifestyle characteristics were detected.

Table 1 Comparison between IBS patients and normal students regarding socio-demographic characteristics

	Normal *N* (%)	IBS patient *N* (%)	Chi-square	*p*
Sex				
Male	183 (70.1)	67 (55.4)	7.95	0.006[a]
Female	78 (29.9)	54 (44.6)		
GPA				
Accepted	92 (41.1)	34 (38.2)	0.624	0.892
Good	77 (34.4)	30 (33.7)		
Very good	44 (19.6)	19 (21.3)		
Excellent	11(4.9)	6 (6.7)		
Academic stage				
Junior years	148 (56.7)	55 (45.5)	4.202	0.04[a]
Senior years	113 (43.3)	66 (54.5)		
Living condition				
With family	208 (79.7)	90 (74.4)	1.361	0.243
Private house	53 (20.3)	31 (25.6)		
Income				
Enough and exceeds	150 (57.5)	63 (52.1)	0.979	0.322
Enough only or not enough	111 (42.5)	58 (47.9)		
Parents				
Living together	230 (89.8)	100 (83.3)	3.225	0.073
Divorce/dead (one or both)	26 (10.2)	20 (16.7)		
BMI				
Underweight	3 (1.3)	6 (5.1)	4.508	0.105
Normal	143 (62.4)	73 (61.9)		
Overweight	55 (24.0)	32 (27.1)		
Obese	28 (12.2)	7 (5.9)		
Family History of IBS				
Yes	57 (21.8)	80 (66.1)	6.289	0.012[a]
No	204 (78.2)	41 (33.9)		

[a]Significant

Table 3 shows no statistically significant difference regarding other health problems characteristics, or regarding emotional stress in the past 6 months.

Table 4 shows no statistically significant differences regarding food frequency questionnaire items.

Table 5 shows a significant difference between IBS cases and normal participants regarding the presence of morbid anxiety ($p = 0.001$) and occurrence of traumatic events during childhood ($p = 0.004$). Causes of traumatic events were mentioned as follows: death of a close family member (46.6%), experiencing serious illness or major surgery (22%), extreme financial difficulty (15.7%), divorced parents (8.5%), and 7.2% experienced a natural disaster which affected their lives negatively.

Table 6 shows a statistically significant difference regarding morbid anxiety and depression in IBS subtypes ($p = 0.02$ and < 0.0001 respectively).

A multivariate logistic regression shows that IBS is significantly associated with positive family history, being a female, occurrence of traumatic events in childhood and performing regular exercise which proved to be protective from IBS (p values are < 0.0001, 0.003, 0.005, and 0.041 respectively) Table 7.

Table 2 Comparison between IBS patients and normal students regarding lifestyle characteristics

	Normal *N* (%)	IBS patient *N* (%)	Chi-square	*p*
Regular exercise				
Yes	111 (42.5)	34 (28.1)	7.309	0.007[a]
No	150 (57.5)	87 (71.9)		
Sleeping hours				
< 8 h/day	140 (53.6)	64 (52.9)	0.019	0.892
≥ 8 h/day	121 (46.4)	57 (47.1)		
Smoking				
Yes	21 (8.0)	12 (9.9)	0.367	0.545
No	240 (92)	109 (90.1)		
Having breakfast[b]				
Always	66 (25.3)	27 (22.3)	.404	0.817
Sometimes	142 (54.4)	68 (56.2)		
Rarely	53 (20.3)	26 (21.5)		
Chewing process				
Eating slowly	36 (13.8)	18 (14.9)	2.146	0.342
Normal	170 (65.1)	70 (57.9)		
Eating fast	55 (21.1)	33 (27.3)		
Drink fluid with meal				
Yes	136 (52.1)	57 (47.1)	0.827	0.363
No	125 (47.9)	64 (52.9)		

[a]Significant
[b]Always = all the days in a week, Sometimes = 2–4 days/week, Rarely = less than 2 days/week

Table 3 Comparison between IBS patients and normal students regarding health problems

	Normal *N* (%)	IBS patient *N* (%)	Chi-square	*p*
Chronic health problem				
Yes	34 (13)	20 (16.5)	0.835	0.361
No	227 (87)	101 (83.5)		
Medication use				
Yes	65 (24.9)	41 (33.9)	3.325	0.068
No	196 (75.1)	80 (66.1)		
Traveler's diarrhea				
Yes	18 (6.9)	13 (10.7)	1.641	0.2
No	243 (93.1)	108 (89.3)		
Food allergy				
Yes	38 (14.6)	19 (15.7)	0.085	0.77
No	223 (85.4)	102 (84.3)		
Emotional stress in previous 6 months				
Yes	178 (70.4)	87 (75)	0.848	0.357
No	75 (29.6)	29 (25)		

4 Discussion

Irritable bowel syndrome (IBS) is a gastrointestinal disorder, characterized by altered bowel habits with abdominal discomfort or pain with the absence of organic pathology. IBS is a highly prevalent disorder that has a great impact on patients' quality of life [21]. In this work, we aimed to study the frequency of IBS in the selected study sample and to find out the associated factors related to this illness.

The frequency of IBS among studied medical students (no. = 382) was 31.7%. Moreover, 26.6% was IBS-D subtype and 37.4% was IBS-C subtype. This result is similar to a study performed in Saudi Arabia, King Abdulaziz University in Jeddah. They examined 597 medical students and interns and reported an IBS prevalence of about 31.8% [15]. Similarly, a medical school in Korea reported that 29.2% of medical students suffered from IBS [22]. In a medical school in Karachi, Pakistan, a study reported the prevalence of IBS to be 28.3% among its students [23]. Similarly, a study from Aga-Khan University in Pakistan found that 26% of its medical students suffer with IBS [24]. Other studies have reported a lower prevalence of IBS among medical students. In a Malaysian medical school, a study conducted on its students reported that 15.8% of them experienced IBS [25]. Two studies from Iran, the first from Shiraz University of Medical Sciences, the second from Gilan University, showed that 16.4% and 12.6% of medical students had IBS, respectively [9]. The highest prevalence of IBS among medical students was reported in a study from Japan, which revealed a prevalence of 35.5% among participants [13], while the lowest prevalence of IBS among

Table 4 Comparison between IBS patients and normal students regarding food frequency questionnaire

	Normal *N* (%)	IBS patient *N* (%)	Chi-square	*p*
Vegetables				
Twice/week or less	90 (34.5)	37 (30.6)	0.568	0.451
3 times/week or more	171 (65.5)	84 (69.4)		
Fruits				
Twice/week or less	81 (31)	48 (40)	2.951	0.086
3 times/week or more	180 (69)	72 (60)		
Eggs, Milk and dairy products				
Twice /week or less	92 (35.2)	50 (41.3)	1.306	0.253
3 times/week or more	169 (64.8)	71 (58.7)		
Fish				
Twice/week or less	227 (87.3)	112 (92.6)	2.324	0.127
3 times/week or more	33 (127)	9 (7.4)		
Nuts				
Twice/week or less	225 (87.2)	106 (88.3)	0.095	0.758
3 times/week or more	33 (12.8)	14 (11.7)		
High-fat diet				
Twice/week or less	174 (66.9)	89 (73.6)	1.698	0.193
3 times/week or more	86 (33.1)	32 (26.4)		
Fast food				
Twice/week or less	153 (58.8)	74 (61.7)	0.272	0.602
3 times/week or more	107 (41.2)	46 (38.3)		
Home-made food				
Twice/week or less	74 (28.4)	43 (36.1)	2.323	0.127
3 times/week or more	187 (71.6)	76 (63.9)		
Coffee				
Twice/week or less	123 (47.3)	61 (50.4)	0.319	0.572
3 times/week or more	137 (52.7)	60 (49.6)		
Tea				
Twice/week or less	99 (38.1)	43 (35.8)	0.177	0.674
3 times/week or more	161 (61.9)	77 (64.2)		
Spicy food				
Twice/week or less	171 (65.5)	76 (62.8)	0.265	0.607
3 times/week or more	90 (34.5)	45 (37.2)		
Artificial sweeteners				
Twice/week or less	217 (83.8)	109 (90.1)	2.684	0.101
3 times/week or more	42 (16.2)	12 (9.9)		
Processed food				
Twice/week or less	141 (54.4)	69 (57.5)	0.311	0.577
3 times/week or more	118 (45.6)	51 (42.5)		

medical students was reported in Northern China to be 9.3% [26]. This variation in the prevalence of IBS among medical students might be explained by either students not identifying symptoms as IBS-related or by variation in the prevalence of IBS in the general population.

The majority of IBS cases, in this work, were females with a significant difference ($p = 0.006$). A Korean study found that the prevalence of IBS was more in males than females, being 41% and 25%, respectively [22]. Another study in Pakistan stated that IBS was more common in

Table 5 Comparison between IBS and normal students as regards depression and anxiety scores

	Normal *N* (%)	IBS patient *N* (%)	Chi-square	*p*
Anxiety				
Normal	120 (46)	32 (26.4)	13.18	0.001[a]
Borderline	63 (24.1)	39 (32.2)		
Abnormal	78 (29.9)	50 (41.3)		
Depression				
Normal	122 (46.7)	50 (41.3)	2.07	.355
Borderline	75 (28.7)	33 (27.3)		
Abnormal	64 (24.6)	38 (31.4)		
Traumatic events during childhood				
Yes	140 (53.6)	84 (69.4)	8.49	0.004*
No	121 (46.4)	37 (30.6)		

[a]Significant

males than females [24]. However, Wells et al. reported that female-to-male ratio in medical students affected with IBS was 2:1 [27]. In a Pakistani study, females had a significant increase in prevalence of IBS, compared to males, and a Malaysian study reported a similar result [23, 25]. Similarly, another study in Japan reported 41.5% of females had IBS symptoms compared to 13.8% of males [13]. An Indian study reported the same findings, being more in females [28]. Qureshi et al. reported that there is no exact effect of gender on the prevalence of the disease among medical students [21]. Studies reporting a higher prevalence of IBS among female students explained this gender predilection of the disease by possible variation in social characters and health-seeking behaviors. Also, the stress and symptoms encountered during the menstrual cycle might lead to more females reporting IBS-related symptoms. This was reported by Triadafilopoulos et al. who studied the prevalence IBS in women going through their climacteric and postmenopausal periods, including 170 postmenopausal and 58 premenopausal females [29]. On the opposite hand, studies reporting a higher prevalence of the disease among males suggested that the cultural barrier can be a limiting factor leading to less female students reporting the disease [24].

Table 6 Comparison between IBS subtypes as regards depression and anxiety scores

	IBS-D	IBS-C	Chi square	p
Anxiety				
Normal	8 (18.6)	24 (30.7)	7.78	0.02[a]
Borderline	10 (23.3)	29 (37.2)		
Abnormal	25 (58.1)	25 (32.1)		
Depression				
Normal	13 (30.2)	37 (47.4)	15.3	< 0.0001[a]
Borderline	7 (16.3)	26 (33.3)		
Abnormal	23 (53.5)	15 (19.3)		

[a]Significant

The mean age in this study was 20.69 ± 3.99. Some studies reported that it is more common among age groups below 25 years [30]. However, typical medical students' age range does not vary significantly in different medical schools, which devalues the comparison based on this factor. A study from Jeddah, Saudi Arabia showed that the prevalence of IBS was higher in senior years, which was attributed to the higher study load rather than the difference in age [15]. This study revealed a significant difference regarding the academic year, being 52.8% in junior years (1st, 2nd, and 3rd years), and 47.2% in senior years. This difference may be related to the stress facing the new attendants to the faculty.

Physical and psychological stresses are considered major contributing factors to IBS etiology. The exact mechanism is not clear, but it is believed that the changes in central nervous system (CNS) in response to psychological and physical stressors lead to colonic spasms, which results in the manifestation of IBS symptoms [3]. Medical students are likely to be under a lot of stress due to the tremendous academic load [24]. In this study, we assessed psychological problems and found that almost two-thirds of our students with IBS were having emotional stress in their past 6 months, 32.9% were anxious and 26.1% were depressed, 26.3% were borderline anxious and 27.2% were borderline depressed. The current results showed a significant difference regarding anxiety, being higher in IBS patients, especially the diarrhea-predominant subtype (IBS-D). Depression showed highly significant difference in relation to IBS subtypes, being higher in the diarrhea predominant subtype too. Similarly, a study in Jeddah, Saudi Arabia, reported that 40.1% of students with IBS had morbid anxiety, and 41.9% had morbid depression, compared to IBS students with borderline depression (29.5%) and with no depression (31.5%) [15]. Similar results were also obtained from King Saud University in Saudi Arabia and from Malaysian studies [25, 31]. A Pakistani study showed that 55.8% of IBS causes were associated with stress [23]. The Malaysian study also reported higher rates of depression in IBS students [25]. Okami et al. in Japan also reported a significantly higher level of anxiety and depression among IBS students [13].

Regarding special habits, unexpectedly, smoking was not found to be associated with high IBS prevalence and only 10% of IBS students were smokers. A study from Jeddah, Saudi Arabia showed similar results with no significant association between smoking and having IBS [15]. However, a study from India reported an association between cigarettes smoking and IBS [28]. Regular exercise as a lifestyle habit was significantly protective

Table 7 Multivariate logistic regression to explore IBS-associated determinants

	B	S.E.	P value	Odds ratio	95% C.I. for odds ratio	
					Lower	Upper
Positive family history	1.934	0.267	< 0.0001[a]	6.917	4.096	11.681
Sex (Ref: male)	0.808	0.273	0.003[a]	2.243	1.315	3.828
Traumatic events	0.782	0.280	0.005[a]	2.187	1.264	3.783
Regular exercise	− 0.570	0.279	0.041[a]	0.565	0.327	0.977
Anxiety	0.390	0.284	0.169	1.477	0.847	2.576
Academic stage (Ref: Junior years)	0.299	0.265	0.258	1.349	0.803	2.266
Constant	− 2.633	0.384	0.000	0.072		

[a]Significant

against developing IBS in this study and few other studies. Further, 71.9% of students with IBS were not performing regular exercise in this study. A study from Saudi Arabia found that IBS prevalence was higher (37.3%) among students who did not exercise regularly compared to those who did (26.1%) [15]. Similarly, a study in Japan reported that students with IBS were performing less exercise than students with no IBS [13].

Eating habits and dietary balance can play a very important role in the development and severity of IBS-related symptoms. These factors are particularly important in students as they are more likely to be less cautious with their diet. Items discussed were chewing well; having breakfast; drinking plenty of fluids; favoring fresh food like fruits, vegetables, nuts, fish, and dairy products; consuming excess spicy or processed food; and drinking excess coffee or tea. Unfortunately, we did not find significant relation between types of food or food habits and IBS prevalence. Similar findings were reported in the study from Jeddah, Saudi Arabia that showed no relation between different food types and the prevalence of IBS [15]. Also, the Malaysian study reported no relation between consumption of chilly or high fiber diet and the risk of developing IBS [25]. On the contrary, the study at King Saud University, Saudi Arabia found that 15.5% of IBS symptoms can be related to dietary factors [31]. A Japanese study showed that patients with IBS consumed more processed food than fresh food [13]. An Indian study reported that fatty food increased the risk of having IBS [28]. Other studies reported that spicy and salty foods were related to development of IBS [22, 32]. Discussing food allergy as a separate entity, no relation was found in this study between food allergy and IBS development. This finding was in line with Almutairi et al. who reported no relation between food allergy and probability of IBS [33]. Unlike that was reported by Carroccio et al., who reported that IBS was more prevalent in those who were allergic to certain types of food [34].

In this study, no significant association was found between travelers' diarrhea and IBS. Almutairi et al. reported that travelers' diarrhea was associated with an increase in the probability of IBS [33].

4.1 Limitations of the study

This study was cross-sectional in design and accordingly causation cannot be proved. A prospective study would be needed to confirm causation. Also, the data used in this study was collected by self-administered questionnaires which is subjective and accordingly can introduce some bias.

5 Conclusion and recommendations

Medical students are likely to be subjected to substantial amounts of stress, anxiety, and depression, those major factors that can account for the increased prevalence of IBS, along with other factors. More studies are probably needed to evaluate the exact impact of IBS on the students' quality of life. Raising awareness among students regarding IBS-related symptoms and factors leading to its development would probably play an important role in mitigating the impact of the disease on their quality of life. Meanwhile, reducing risk factors and implementing preventive strategies are important in controlling the disease and decreasing its undesirable effect.

Acknowledgements
Not applicable.

Authors' contributions
DE contributed in the study design, data collection, and writing the introduction. NEM contributed in the study design, data collection, and writing the discussion. AFM contributed in data collection and analysis and writing the results. All authors read and approved the final manuscript.

Funding
The authors did not receive any external funding for this work.

Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate
Ethical approval was obtained from ethical committee, Faculty of Medicine, Ain Shams University. An informed written consent was obtained from all

the students after informing them about the aim of the study and assuring the confidentiality of all provided data and that no personal identifying data would be used in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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Received: 16 February 2019 Accepted: 4 September 2019
Published online: 04 December 2019

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Publisher's Note

Journal of the American College of Nutrition

ISSN: 0731-5724 (Print) 1541-1087 (Online) Journal homepage: https://www.tandfonline.com/loi/uacn20

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To cite this article: Gamze Yurtdaş, Nilüfer Acar-Tek, Gamze Akbulut, Özge Cemali, Neslihan Arslan, Ayfer Beyaz Coşkun & Fatmanur Humeyra Zengin (2020) Risk Factors for Constipation in Adults: A Cross-Sectional Study, Journal of the American College of Nutrition, 39:8, 713-719, DOI: 10.1080/07315724.2020.1727380

To link to this article: https://doi.org/10.1080/07315724.2020.1727380

JOURNAL OF THE AMERICAN COLLEGE OF NUTRITION
2020, VOL. 39, NO. 8, 713–719
https://doi.org/10.1080/07315724.2020.1727380

Risk Factors for Constipation in Adults: A Cross-Sectional Study

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ABSTRACT

Aim: The objective of this study was to determine associations between physical activity, dietary fiber intake, water and fluid intake, and constipation as well as other possible risk factors for constipation in adults.

Method: A cross-sectional study was conducted in 4561 (1812 male and 2749 female) adults, aged between 18–65 years, living in Ankara, Turkey. Participants having three or fewer bowel movements per week were considered constipated. Dietary fiber and fluid intake data were ascertained from a 62-item food frequency questionnaire (FFQ). The International Physical Activity Questionnaire-Short Form (IPAQ-SF) was used to evaluate participant physical activity.

Results: Of the total cohort, 16.6% were diagnosed with constipation (13.6% males, 18.5% females). Logistic regression analysis showed a significantly greater risk of constipation in participants with female gender, advancing age, being obese. Participants who were moderately active (OR: 0.77, 95% CI: 0.62–0.91) and active (OR: 0.74, 95% CI: 0.59–0.90) had a decreased likelihood of constipation, when compared with inactive participants ($p < 0.05$). Participants in the middle upper quartile for water intake (OR: 0.71, 95% CI: 0.57–0.88), had a decreased likelihood of constipation, when compared with participants in the lowest quartile. Participants in the middle upper quartile (OR: 0.74, 95% CI: 0.58–0.92) and the highest quartile for dietary fiber intake (OR: 0.66, 95% CI: 0.52–0.84), had a decreased likelihood of constipation, when compared with participants in the lowest quartile ($p < 0.05$).

Conclusion: Constipation is common in the Turkish adult population. Insufficient physical activity, decreasing fiber and water intake, obesity, advancing age and female gender were associated with increased constipation risks. Combining regular physical activity and increasing fiber and water intake may protect from constipation, and relieve constipation symptoms.

Abbreviations: BMI: body mass index; IPAQ-SF: International Physical Activity Questionnaire-Short Form; FFQ: food frequency questionnaire; USDA: US Department of Agriculture; WHO: World Health Organization

ARTICLE HISTORY
Received 26 September 2019
Accepted 4 February 2020

KEYWORDS
Dietary fiber intake; fluid intake; constipation; physical activity; water intake

Introduction

Constipation is defined by continuous stress or incomplete defecation and/or rare bowel movements (every three to four days or less), according to the Global Guidelines of the World Gastroenterology Organisation (1). It is estimated that approximately 14% of the world's population suffers with constipation (2). According to studies conducted in Turkish populations, the prevalence of constipation varies between 8.3% and 40% (3, 4).

Constipation is a chronic situation which adversely affects the quality of life (5). Because of these features, constipation is accepted as a significant public health problem. Determining strategies to ameliorate this problem requires the exploration of factors associated with constipation (5). Several risk factors have been identified from previous studies, including female gender, advanced age, low income and education level, medication use (e.g. opioids, calcium channel blockers and antidepressants) and the presence of comorbidities (6, 7). In addition, dietary and lifestyle factors, such as inadequate fluid, water and fiber intake, low physical activity, low consumption of vegetables and fruits, and excessive coffee and tea consumption, have all been associated with constipation (8–10). However, results and data from studies evaluating relationships between constipation and dietary fluid and fiber intake, are inconsistent. For example, some researchers support the relationship between constipation and dietary fiber intake (11), whilst others report no differences in dietary fiber intake between subjects with constipation and controls (12). In a previous study, a low dietary intake of fluids increased the odds of having constipation, but not increasing dietary fiber intake (2). Studies focusing on physical activity and constipation in adults are few, with often contradictory results. In a study

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on women, a negative association was reported between physical activity and constipation (10), while another study found no associations between physical activity and constipation in adults (2).

Due to the limited number, and conflicting results from previous studies, an evaluation of several variables, including demographics, lifestyle factors and dietary factors in a large adult population may show reveal definitive associations with constipation. Therefore, this study examined associations between physical activity, dietary fiber, water and fluid intake, and constipation, as well as other possible risk factors in adults.

Materials and methods

Study population

This cross-sectional study was conducted in adults aged 18–65 years between May 2018 and September 2018. The study was performed in community health centers, in central districts of Ankara, Turkey. Volunteer participants were recruited to the study. They were informed about the study, and signed a participation consent form which adhered to the Declaration of Helsinki protocols (World Medical Association). Study data was generated via a questionnaire, using face to face interviews. In total, 5040 adults filled out the questionnaire. Participants diagnosed with irritable bowel syndrome (n = 42), those using products and medications affecting bowel movements (laxatives, opioids, calcium channel blockers, antidepressants, pre- and probiotics and magnesium tablets) (n = 199), pregnant/lactating women (n = 15), participants with missing values or outliers for some questions (n = 166), and participants with intentional dietary changes within the preceding month (n = 57), were excluded. This resulted in a final number of 4561 participants (1812 male and 2749 female). Ethical approval (reference number 2018202) was obtained from the Gazi University Ethics Committee.

Assessment of constipation status

Constipation was determined as less than three defecations per week and was assessed by a single question regarding defecation frequency (2).

Dietary fiber, water and fluid intake

Dietary fiber (g/d) and water and fluid intake (mL/d) were assessed by a 62-item food frequency questionnaire (FFQ), structured to evaluate the frequency of food group consumption. This semi-quantitative FFQ was previously validated to assess dietary intake in Turkish adults (13). It was modified according to other FFQ's, which were developed to evaluate dietary habits related to constipation (14, 15). The FFQ was modified considering the most frequently consumed foods in the Turkey to adapt Turkish diet.

Participants were asked how frequently and how much they consumed items from certain food groups (whole-grain foods, bread, pasta/rice, potatoes, fruit, vegetables, legumes, tea, coffee, ayran (yogurt-water), kefir (fermented milk), milk, non-carbonated beverage and alcoholic beverages) over the previous month. The study coordinator explained to the participants how to complete the FFQ. A "Food and Nutrition Photo Catalogue" was used to help participants correctly remember measurements and amounts of food and beverages consumed. Constipation and food consumption frequencies during the previous month were assessed, reflecting the previous month's dietary habits. The US Department of Agriculture (USDA) (National Nutrient Database for Standard Reference, Release 25 Software v.1.2.2) database was used for evaluating fiber intake (16). Fiber, water and fluid intake were assessed by quartiles.

Anthropometric measurements

Participant weight (kg) was measured using the Medical Scale DR-Mod 85 brand electronic scale. Height was measured (cm) with feet close together and the head in the Frankfort plane, using a portable stadiometer, with 0.1 cm accuracy. The body mass index (BMI) was calculated by dividing body weight (kg) by height squared (17). BMI data were classified as obese ($\geq$30 kg/m^2), overweight (25–29.9 kg/m^2), or normal weight ($<$25 kg/m^2), according to World Health Organisation (WHO) classifications.

Physical activity

The International Physical Activity Questionnaire-Short Form (IPAQ-SF) was used to evaluate the physical activity of participants. Data were evaluated using the "International Physical Activity Short Form Evaluation Guide". Accordingly, participants were classified into three groups; inactive, moderately active and active (18).

Statistical analyses

Analyses were performed using SPSS software for Windows (Statistical Package for Social Sciences, version 23.0, Chicago, IL, USA). Chi-square tests or Fisher exact tests determined the constipation status according to age, BMI, marital status, education, chronic disease, smoking and alcohol consumption, for males and females. For multivariate analyses, the factors identified by univariate analysis were further entered into a logistic regression analysis to determine independent predictors of participant outcomes. Hosmer–Lemeshow goodness of fit statistics were used to assess model fit. A p value < 0.05 was statistically significant, and the p value was two-sided.

Results

In total, 4561 participants were included in the study, 1812 (39.7%) were male and 2749 (60.3%) were female. The mean age of participants was 32.5 ± 11.84 years (data not shown in tables). Of the total cohort, 16.6% were diagnosed with constipation (13.6% of males, 18.5% of females). A statistically significant relationship was determined between constipation

Table 1. Comparison of constipation prevalence according to gender.

	Male (n = 1812)		Female (n = 2749)		Total (n = 4561)		
Stool frequency (per week)	n	%	n	%	n	%	*p* value
Constipated (<3)	246	13.6	509	18.5	755	16.6	**<0.001**
Non-constipated (≥3)	1566	86.4	2240	81.5	3806	83.4	

p was calculated by chi-square test. Significant values are shown in bold ($p < 0.05$).

status and gender ($p < 0.001$). The prevalence of constipation was higher in females than males (Table 1).

The characteristics of participants according to their constipation status are shown (Table 2). There was a statistically significant association between constipation and age, BMI, marital status, educational level, presence of chronic disease and physical activity ($p < 0.05$). However, no association was found between constipation and smoking ($p > 0.05$). Constipation prevalence increased with advancing age, from 12.6% in the 18–29 age group, to 27.3% in the 60–65 age group ($p < 0.05$).

Obese (BMI > 30 kg/m^2) participants had a higher prevalence of constipation (25.3%), when compared with those who were overweight (BMI = 25–29.9 kg/m^2) (17.2%), and those with a normal weight (BMI < 25 kg/m^2) (14.3%) (Table 2).

Constipation prevalence increased with physical activity, from active (13.2%), moderately active (14.9%), to inactive (20.6%) ($p < 0.05$) (Table 2).

Table 3 shows dietary fiber, water and fluid intake of participants with/or without chronic constipation. There was a statistically significant relationship between constipation, and fiber and water intake. Constipation prevalence was higher in participants at the middle lower quartile of dietary fiber intake (19.3–26.1 g/d), and total dietary fluid intake (1862.7–2393 mL/d). Constipation prevalence was higher in participants at the lowest quartile of water intake (19%), when compared with other quartiles of water intake.

Table 4 shows the dietary fiber, water, beverage and fluid intake according to constipation status. The non-constipated group had significantly increased fiber, fruit juice and carbonated beverage intake, but lower tea intake when compared with the constipated group ($p < 0.05$). No significant differences were found in water and fluid intake between the constipated and non-constipated groups ($p > 0.05$).

Binomial logistic regression analysis of factors associated with constipation are shown (Table 5). These data show a significantly greater risk of constipation in female participants (OR: 1.49, 95% CI: 1.25–1.78), advancing age (OR: 1.01, 95% CI: 1.01–1.02), obesity (OR: 1.57, 95% CI: 1.22–2.02), whereas fluid intake was not associated with constipation.

According to IPAQ scores, moderately active participants (OR: 0.77, 95% CI: 0.62–0.91) and active participants (OR: 0.74, 95% CI: 0.60–0.91) had a decreased likelihood of constipation, when compared with inactive participants ($p < 0.05$) (Table 5).

Participants in the middle upper quartile of dietary fiber intake (OR: 0.74, 95% CI: 0.58–0.92), and in the highest quartile of dietary fiber intake (OR: 0.66, 95% CI: 0.52–0.84) had a decreased likelihood of constipation, when compared with participants in the lowest quartile of dietary fiber intake ($p < 0.05$). Participants in the middle upper quartile of water intake (OR: 0.71, 95% CI: 0.57–0.88) had a decreased likelihood of constipation, when compared with participants in the lowest quartile of water intake ($p < 0.05$) (Table 5).

Discussion

Constipation is a common problem in adults, and its prevalence varies according to diagnostic criteria (3, 19, 20). In this study, the prevalence of constipation was found to be 16.6% in a Turkish population (Table 1). However, in another Turkish study, the constipation prevalence was 8.3%, according to ROMA II criteria (4, 21). In a systematic review and meta-analysis, it was reported that the worldwide prevalence of chronic constipation, according to self-reported questionnaires or specific symptom-based criteria, was 14% (6). In South America, the prevalence was 18%, in northern and southern Europe, 16%, and in the Middle East and South Asia, the constipation prevalence was 14% and 11%, respectively (6). Constipation rates in different countries may be influenced by societal, cultural and socio-economic characteristics, as well as subjective data recall and acquisition by individuals. In this study, we determined the prevalence of constipation in our cohort was similar to the prevalence of constipation across the world.

In several studies, the prevalence of constipation was reported to be higher in females than for males (22, 23). Consistent with the literature, this study also demonstrated that females were more likely to have constipation (18.5%), than males (13.6%) (Table 1). Binominal logistic regression analysis showed that being female increases the risk of having constipation by 1.49 times (OR: 1.49, 95% CI: 1.25–1.78) (Table 5). In a systematic review, it was reported that females in North America had a 2.2 times higher constipation prevalence, when compared to males (24). The reasons why females have higher constipation risks can be attributed to hormonal factors, for example, in the luteal phase of the menstrual cycle, progesterone appears to increase the risk of constipation (25). Another reason may be that during gynecological surgery, pelvic floor muscles can be damaged (25). In addition, the nerves required for defecation are vulnerable to injury in females (23).

Constipation frequency generally increases with age, and adversely affects quality of life (26). In this study, for both males and females, the constipation rates were highest at ages 60–65 (27.3%) (Table 2). Advancing age (OR: 1.01, 95% CI: 1.01–1.02) was associated with an increased risk for constipation (Table 5). The presence of comorbidities, increased drug use, low energy intake and a sedentary lifestyle were some of the reasons why constipation was more common

Table 2. The characteristics of the participants according to their constipation status.

		Constipated (n = 755)	Non-constipated (n = 3806)	Prevalence of constipation (%)	*p* value
Age (years)	18–29	292 (38.7%)	2024 (53.2%)	12.6	
	30–39	183 (24.2%)	796 (20.9%)	18.7	
	40–49	160 (21.2%)	573 (15.1%)	21.8	**<0.001**
	50–59	85 (11.3%)	320 (8.4%)	21.0	
	60–65	35 (4.6%)	93 (2.4%)	27.3	
BMI (kg/m^2)	Normal	373 (49.4%)	2231 (58.6%)	14.3	
	Overweight	239 (31.7%)	1153 (30.3%)	17.2	**<0.001**
	Obese	143 (18.9%)	422 (11.1%)	25.3	
Marital Status	Married	449 (59.5%)	1801 (47.3%)	19.4	**<0.001**
	Single/divorced	306 (40.5%)	2005 (52.7%)	13.6	
Educational level	Illiterate	8 (1.1%)	38 (1.0%)	17.4	
	Literate	27 (3.6%)	88 (2.3%)	23.5	
	Primary school	91 (12.1%)	322 (8.5%)	22.0	**<0.001**
	Secondary school	29 (11.8%)	231 (6.1%)	9.8	
	High school	65 (8.6%)	1093 (28.7%)	5.0	
	University	348 (46.1%)	2034 (53.4%)	14.6	
Chronic disease	Yes	302(40.0%)	1007 (26.5%)	23.1	**<0.001**
	No	453 (60.0%)	2799 (73.5%)	13.9	
Smoking	Yes	75 (30.5%)	82 (16.1%)	7.0	0.171
	No	171 (69.5%)	427 (83.9%)	4.9	
Alcohol consumption	Yes	31 (12.6%)	32 (6.3%)	5.9	**0.012**
	No	215 (87.4%)	477 (93.7%)	5.3	
Physical activity	Inactive	355 (47.0%)	1367 (35.9%)	20.6	
	Moderately active	216 (28.6%)	1232 (32.4%)	14.9	**<0.001**
	Active	184 (24.4%)	1207 (31.7%)	13.2	

p was calculated by chi-square test. BMI: body mass index. Significant values are shown in bold ($p < 0.05$).

Table 3. Dietary fiber, water and fluid intake of the participants with and without constipation.

	Constipated (n = 755)	Non-constipated (n = 3806)	Prevalence of constipation (%)	*p* value
Dietary fiber intake				
Lowest quartile (<19.3 g/d)	202 (26.8%)	935 (%24.6)	11.7	
Middle lower quartile (19.3–26.1g/d)	232 (30.9%)	899 (%23.7)	20.5	**<0.001**
Middle upper quartile (26.1–34.2 g/d)	173 (23.0%)	979 (%25.8)	15.0	
Highest quartile (>34.2 g/d)	148 (19.7%)	993 (%26.2)	13.0	
Water intake				
Lowest quartile (<1000 mL/d)	269 (35.6%)	1146 (30.1%)	19.0	
Middle lower quartile (1000–1500 mL/d)	202 (26.8%)	1020 (26.8%)	16.5	**<0.001**
Middle upper quartile (1500–2000 mL/d)	176 (23.3%)	1163 (30.6%)	13.1	
Highest quartile (>2000 mL)	108 (14.3%)	477 (12.5%)	18.4	
Total dietary fluid intake				
Lowest quartile (<1862.7 mL/d)	195 (25.8%)	945 (24.8%)	17.1	
Middle lower quartile (1862.7–2393 mL/d)	213 (28.2%)	928 (24.4%)	18.7	0.068
Middle upper quartile (2393–3023.7 mL/d)	169 (22.4%)	971 (25.5%)	14.8	
Highest quartile (>3023.7 mL)	178 (23.6%)	962 (19.8%)	15.6	

p was calculated by chi-square test. Significant values are shown in bold ($p < 0.05$).

Table 4. Amount of dietary fiber, water, beverage and fluid intake of the participants with and without constipation.

	Constipated (n = 755)	Non-constipated (n = 3806)	*p* value
Total dietary fiber (g)	26.7 ± 12.22	28.0 ± 12.24	**0.008**
Water intake (g)	1531.0 ± 755.94	1576.9 ± 694.59	0.105
Milk (mL)	66.0 ± 101.15	75.1 ± 102.82	0.056
Ayran-Kefir (mL)	9.9 ± 36.10	9.8 ± 34.62	0.927
Fruit juice (mL)	50.1 ± 88.00	66.6 ± 120.29	**<0.001**
Tea (mL)	511.5 ± 403.48	460.8 ± 368.84	**0.001**
Coffee (mL)	100.6 ± 153.20	98.1 ± 151.18	0.687
Carbonated beverages (mL)	91.5 ± 121.35	107.9 ± 149.81	**0.005**
Noncorbanated beverages (mL)	5.2 ± 25.03	6.0 ± 38.52	0.595
Alcoholic beverage (mL)	5.8 ± 35.89	8.5 ± 42.96	0.116
Total fluid intake (mL)	2486.8 ± 1114.75	2498.4 ± 926.00	0.762

Data are shown as the mean ± standard deviation. *p* value was calculated by independent *t*-test. Significant values are shown in bold ($p < 0.05$).

with advancing age (27). Weak abdominal and pelvic muscles are also common in older age (28), which may also lead to constipation.

Globally, obesity is increasingly a major health problem, as it causes many diseases and is also a risk factor for functional gastrointestinal diseases (29). In this study, we found that obese participants had a higher prevalence of constipation, when compared with those who were overweight or normal (Table 2). In addition, binomial logistic regression analysis showed that obese participants had a 1.57-fold higher risk of constipation, when compared with overweight or normal weight participants (OR: 1.57, 95% CI: 1.22–2.02)

Table 5. The binomial logistic regression analysis of the factors associated with constipation.

						95% CI	
		B	Standard error	*p* value	OR	Min.	Max.
Age (years)		0.017	0.004	**<0.001**	1.01	1.01	1.02
Gender	Male*						
	Female	0.413	0.089	**<0.001**	1.49	1.25	1.78
BMI (kg/m^2)	Normal*						
	Overweight	0.186	0.099	0.061	1.20	0.99	1.46
	Obese	0.454	0.128	**<0.001**	1.57	1.22	2.02
IPAQ	Inactive*						
	Moderately active	0.277	0.098	**0.005**	0.77	0.62	0.91
	Active	−c.308	0.105	**0.003**	0.74	0.59	0.90
Fiber intake	Lowest q.*						
	Middle lower q.	0.096	0.110	0.382	1.10	0.88	1.36
	Middle upper q.	−i.301	0.116	**0.010**	0.74	0.58	0.92
	Highest q.	−i.404	0.121	**0.001**	0.66	0.52	0.84
Water intake	Lowest q.*						
	Middle lower q.	−0.089	0.105	0.399	0.91	0.74	1.12
	Middle upper q.	−0.337	0.108	**0.002**	0.71	0.57	0.88
	Highest q.	0.149	0.130	0.255	1.16	0.89	1.49

*Reference group, BMI: body mass index, IPAQ: International Physical Activity Questionnaire, q: quartile, CI: confidence interval; OR: odds ratio. Significant values are shown in bold ($p < 0.05$).

In the logistic regression model, age, gender, BMI, physical activity level (IPAQ), fiber intake (quartiles), and water intake (quartiles) were used as covariates.

(Table 5). Similarly, a previous study showed an inverse association between BMI and low bowel movement frequencies (10), whereas other studies could not find this association (30, 31). Although the reasons for a relationship between obesity and constipation are not fully understood, it has been suggested that obesity may increase inflammatory cytokine levels, and cause gastrointestinal symptoms (29). Another explanation for this relationship could be that low physical activity, inadequate dietary fiber intake and having bad nutritional habits (fast food, not eating enough fiber and not drinking enough water) are reasons for obesity and constipation (32). This suggests a connection between obesity and constipation (33).

This study showed that the prevalence of constipation increased with physical activity levels, from inactive (20.6%), moderately active (14.9%) to active (13.2%) (Table 2). According to IPAQ scores, participants who were moderately active (OR: 0.77, 95% CI: 0.62–0.91) and active (OR: 0.74, 95% CI: 0.60–0.91) had a decreased likelihood of constipation, when compared with inactive participants ($p < 0.05$) (Table 5). These findings are consistent with previous studies (5, 10). Physical activity increases movements in the large intestines (34). It has been suggested that hormonal changes during exercise may also affect gastrointestinal motility (10).

To prevent constipation, a high-fiber diet is generally recommended (35). WHO recommends consuming 25–40 g of dietary fiber per day (35). In this study, the dietary fiber intake was 26.7 ± 12.22 g in constipated participants, and 28.0 ± 12.24 g in non-constipated participants (Table 4). Dietary fiber intake levels appeared to be at recommended levels. Participants in the middle upper quartile and highest quartile of dietary fiber intake, had a decreased likelihood of constipation, when compared with participants in the lowest quartile of dietary fiber intake ($p < 0.05$) (Table 5). Consistent with our data, a recent study by Shen et al. (36) investigated associations between fiber and water intake and constipation in US adults. Their results showed that a lower dietary fiber intake was associated with an increased risk of constipation. In a meta-analysis, dietary fiber intake increased stool frequencies in patients with constipation (37). Dietary fiber softens stools, increases the volume and shortens the time in the large intestine (38). Each type of dietary fiber affects different parts of the colon, by their physiological effects, performance, and mechanisms (39). Another potential mechanism of action suggests that fermenting fiber produces short-chain fatty acids, which accelerate colon transit and increases osmotic loads (40).

Inadequate fluid and water intake is generally accepted as a risk factor for constipation (41). The European Food Safety Authority (EFSA) (2010) recommends a daily water intake of 2500 mL/d for men and 2000 mL/d for women. In this study, the daily water intake was 1531.0 ± 755.94 mL for constipated participants and 1576.9 ± 694.59 mL for non-constipated participants. These volumes are less than the daily recommendations. Moreover, the prevalence of constipation was higher in participants at the lowest quartile of water intake (19%), when compared with other water intake quartiles (Table 2). Participants in the middle upper quartile of water intake (OR: 0.71 95% CI: 0.57–0.88) had a decreased likelihood of constipation, when compared with participants in the lowest quartile of water intake ($p < 0.05$) (Table 5). Consistent with this study, Shen et al. (36) found that water consumption was significantly associated with a higher risk of constipation. Some studies also determined inverse relationships between total fluid intake and constipation (2, 5). Total fluid intake was not associated with constipation in this study ($p > 0.05$) (Table 2). Reasons as to why we could not determine a consistent relationship regarding total fluid intake and constipation could be that participants with constipation may have changed their habits for healing. When constipation status was evaluated according to beverage intake, it was found that fruit juice and carbonated beverage consumption were higher, but tea consumption was lower, in constipated participants ($p < 0.05$) (Table 4). Similarly, in previous studies, the consumption of fruit juice and carbonated beverages was associated with constipation (11, 39). Murakami et al. (14) found that a lower intake of Japanese and Chinese tea was associated with a decreased risk of constipation. The relationship between tea and constipation may be explained by theophylline, which causes extracellular dehydration and constipation (42).

The present study had some limitations. First, most variables were obtained by self-report method; that is why the potential a recall bias might be exist. Second, causal relationships between constipation and risk factors could not be determined from this study due to its cross-sectional design. Therefore, future randomized control studies are required to clarify these relationships.

Conclusion

Constipation is common in the Turkish adult population; in this study, the constipation prevalence was high (16.6%).

Logistic regression analysis showed that insufficient physical activities, decreasing fiber and water intake, obesity, advancing age and being female were factors associated with a greater risk of constipation. Combining regular physical activities with an adequate fiber and water intake may protect the individual from constipation, and may relieve constipation symptoms.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Age and Ageing 2017; **46:** 119–124
doi: 10.1093/ageing/afw166
Published electronically 12 September 2016

Prevalence and factors associated with faecal impaction in the Spanish old population

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Abstract

Background: faecal impaction (FI) is a common problem in old people living in nursing home. Its prevalence and associated factors remain unknown in the general population.
Aim: to evaluate FI prevalence in the Spanish population older than 65 years and to assess the factors associated with it.
Methods: a telephone survey was carried out of a Spanish population older than 65 years random sample (N = 1000). FI was assessed using a previously validated questionnaire.
Results: a total of 28,128 calls were made; 1,431 subjects were eligible and 1,000 subjects were enrollled, mean aged 74.6 ± 7.3 (65–97); 57.5% were women. At least 53 people reported FI within the past year (5.3% (CI 95%: 3.9–6.7%)). Only 0.03% met criteria for chronic constipation and faecal incontinence. FI-associated factors were constipation, female gender, reduced physical activity, and chronic renal failure (CRF).
Conclusion: FI is a prevalent problem in old Spanish population. Constipation and female gender are the main associated factors; low physical activity and CRF appear to play also a significant role. Further studies are required to confirm this association.

Keywords: *constipation, prevalence, impaction, incontinence faecal impaction, faecal incontinence, older people*

Introduction

Faecal impaction (FI) is defined as the inability to pass large, hardened stools through the rectum or lower colon [1]. Its prevalence in general population remains unknown, despite of its consideration as a relevant problem in old people, especially in those with neurological comorbidity and bedridden persons [2]. FI incidence in old people living in nursing homes is about 50% per year, and it has been published that FI prevalence is about 7% in the same sample if a digital rectal examination is performed [3].

FI diagnosis is usually made by rectal examination and radiology, since symptoms are not specific [4]. An FI questionnaire previously developed and validated by our group [5] is an easy way to evaluate FI. It showed a kappa of 0.72 compared to the medical diagnosis, and the analysis of 687 subjects enrolled in a study in nursing homes maintained this kappa at a value of 0.69 [3]. It consists of three questions about the antecedent of a hard mass in the rectum impossible to evacuate, the method used to resolve it and its frequency in the last year. This questionnaire is currently used in some nursing homes in our community as screening of FI. In this study, FI is defined as at least one event in the past year of hard stools that the person was unable to pass on their own, requiring the help of another person.

FI-associated factors are scarcely known. They are supposed to be the same as constipation [6]. In old people living in a nursing homes, constipation, number of drugs, low functional capacity and nonsteroidal anti-inflammatory drugs (NSAIDs) were shown to be FI-associated factors [3]. Increasing age and heart or neurological disease seem to be predictors of in-hospital complications in patients with FI [7]. However, associated factors in community-living old people are unknown.

FI complications are multiple and potentially fatal [8]. Faecal incontinence is considered the main one, since it is a common problem that affects 8% of general population [9],

and up to 50% in the institutionalised old people [10]. Prevalence of faecal incontinence in old people living in nursing homes diagnosed of FI is 28.2% [3], and 20% of the institutionalised old people who developed faecal incontinence in a year had FI [11].

The burden of FI in terms of quality of life and costs remains unknown. However, constipation and faecal incontinence, both related to FI, are known to have a significant impact on quality of life [12, 13], on emotional wellness [14] and high economic cost [13]. FI seems to be relevant in terms of emergency department (ED) visits, with an overall rate of 32 per 100,000 ED visits [15].

From a pathophysiological standpoint, chronic constipation (CC) may cause FI at any level of the colon when colonic motility is impaired, in addition to other factors such as low fibre liquid intake and low physical activity, which are common among old people [16]. When FI occurs at rectal level, probably secondary to defecatory disorders [17], it maycause gradual decline in rectal sensitivity and contractile capacity, both fundamental to maintaining continence [18]. However, the association between CC, FI and faecal incontinence has not been studied in old people living in the community.

The primary objective of this study was to evaluate the prevalence of FI in the non-institutionalised population over 65 years old and the factors associated with it. Secondary objectives were to evaluate the prevalence of constipation and faecal incontinence in this population, to study the associated risk factors, especially comorbidity and drugs, and to find out the relationship between constipation, FI and faecal incontinence.

Material and methods

Study design and population

A random sample of the Spanish population over 65 years old was obtained from the national telephone directory in electronic format. A proportional distribution of the sample was accepted by Region or Province and municipality size, selecting individuals based on quotas of sex and age according to the 2010 Spanish Census. The study was approved by the Ethics Committee of San Carlos Clinical Hospital (Madrid, Spain). The required sample size was established at 1,000, which allowed for an estimated FI prevalence of 2%, with a 2% margin of error.

Data were collected using computer-assisted telephone interviews by previously trained interviewers. Phone calls were made in October 2011. The subject was asked for his/her consent to participate in the study after a brief description of the study. The objectives were not specified in order to avoid participation bias. People older than 65 years who gave their consent to participate, able to understand and respond questions and Spanish as mother language were included.

Data collection and definition of variables

FI was defined and assessed as previously mentioned. CC was defined according to Rome III consensus and assessed by the Rome III questionnaire [19]. Faecal incontinence was defined as involuntary leakage of faeces occurring at least once a month over the previous 3 months, collected by Rome III questionnaire [20].

For sociodemographic and general data evaluation, appropriate questions were used from a validated questionnaire for telephone interview in Spanish [21]. Fluid, fibre intake and physical activity were examined with a questionnaire previously used in two studies [3, 22]. Comorbidities were collected using direct questions about the presence of diabetes, Parkinson's disease, thrombosis, stroke, depression, heart failure, renal failure, cholecystectomy and colorectal surgery. The self-reported diagnosis of these diseases is considered reliable in old people [23]. Participants were asked to provide the names of the drugs they are taking, apart from laxatives, which were coded by the group they belonged.

Statistical analysis

A descriptive analysis was carried out, including frequency of FI, constipation and faecal incontinence, together with their corresponding 95% confidence intervals.

A logistic regression multivariate analysis (stepwise forward) was conducted to identify the FI-associated factors, constipation and faecal incontinence, including comorbidities, ASA, NSAIDs, calcium channel blockers, diuretics, opiates and anticholinergic drugs as potentially associated variables in the model, as well as the variables that were associated in the univariate analysis. The model was adjusted by age, sex, physical activity, fluid intake, number of drugs and number of comorbidities. In the case of FI, the presence of constipation was included in the model. Stool frequency and the presence of loose or liquid stools were included in the model for faecal incontinence.

Results

Response rate

A total of 28,128 calls were made, of which 19,971 were invalidated for an impossible contact with them. Of the 8,057 contacts made, 350 did not speak Spanish and 6,276 were non-quota (not older than 65 years), and were thus excluded. Among the 1,431 eligible subjects, 431 refused to participate in the study. Assuming that the percentage of ineligibles would be identical among those not contacted, the response rate of the study was 69.8%, for a total of 1,000 enrolled subjects.

Description of the sample

Sociodemographic characteristics: Participants' mean age was 74.6 ± 7.3 [65–97] years, the most common age range was 71–80 years old (41.2%). Out of them, 57.5% were women. Most were married (59.9%). Primary school studies was the predominant education level (75.7%). Mean Body Mass

Index (BMI) was 26.9 ± 3.3 (16.0–55.0). Urban population was more frequent than rural population (73.7% vs. 26.3%).

Lifestyles and comorbidities of the sample are collected in Supplementary Table 1, available at *Age and Ageing* online.

Use of drugs in the sample are shown in Supplementary Table 2, available at *Age and Ageing* online.

FI and associated factors

FI prevalence: 53 people, 5.3% (95% CI: 3.9–6.7%), met criteria for FI in the past year. Among them, 14 people (26.4%, 95% CI: 25.08–27.7%) had experienced only 1 event, 21 people (39.6%, 95% CI: 37.6–41.6%) had 2–4 episodes and 15 people (25.3%) reported suffering events at least once a month in the past year. The prevalence of recurrent impaction was 75.4% (among subjects with impaction) and 3.6% (95% CI: 2.4–4.8) in the total sample. Figure 1 shows the prevalence FI stratified by age and sex.

Consultation for FI: 34 out of 53 people (64.2%) consulted a doctor for that reason.

Acute treatment: 38 people indicated the use of enemas and 15 needed another person to perform a manual extraction.

Associated factors: In the univariate analysis, age range 71–80 years, feminine gender, widower marital status, ex-smoker, low fibre consumption, moderate physical activity, comorbidities, such as Parkinson's disease, heart failure, kidney failure and depression, and consumption of NSAIDs were associated with FI. FI-associated factors in the multivariate analysis are shown in Table 1.

Constipation and associated factors

Prevalence of constipation: 181 people met the Rome III criteria for CC, which represents a prevalence of 18.1% (95% CI: 15.7–20.5%). Figure 1 shows the prevalence of constipation stratified by age and gender.

Regular use of laxatives: 166 people acknowledged the regular use of laxatives over the past year (16.6%, 95% CI: 14.3–18.9). Out of them, 143 people used only one laxative; bulk forming laxatives was the most consumed (35.7%)

Table 1. Multivariate analysis of factors associated with FI in the population studied

Variable	Category	Adjusted odds ratio
Sex	Female	3.5 (1.5–7.7)
Physical activity	Intense–Moderate (*N* = 479)	1
	Moderate–Mild (*N* = 429)	2.8 (1.–5.8)
	None (*N* = 92)	1.1 (0.4–3.7)
Number of comorbidities		1.4 (1.0–2.0)
Kidney failure	Kidney failure	3.6 (1.4–9.5)
Constipation	Constipation	3.8 (2.0–7.0)

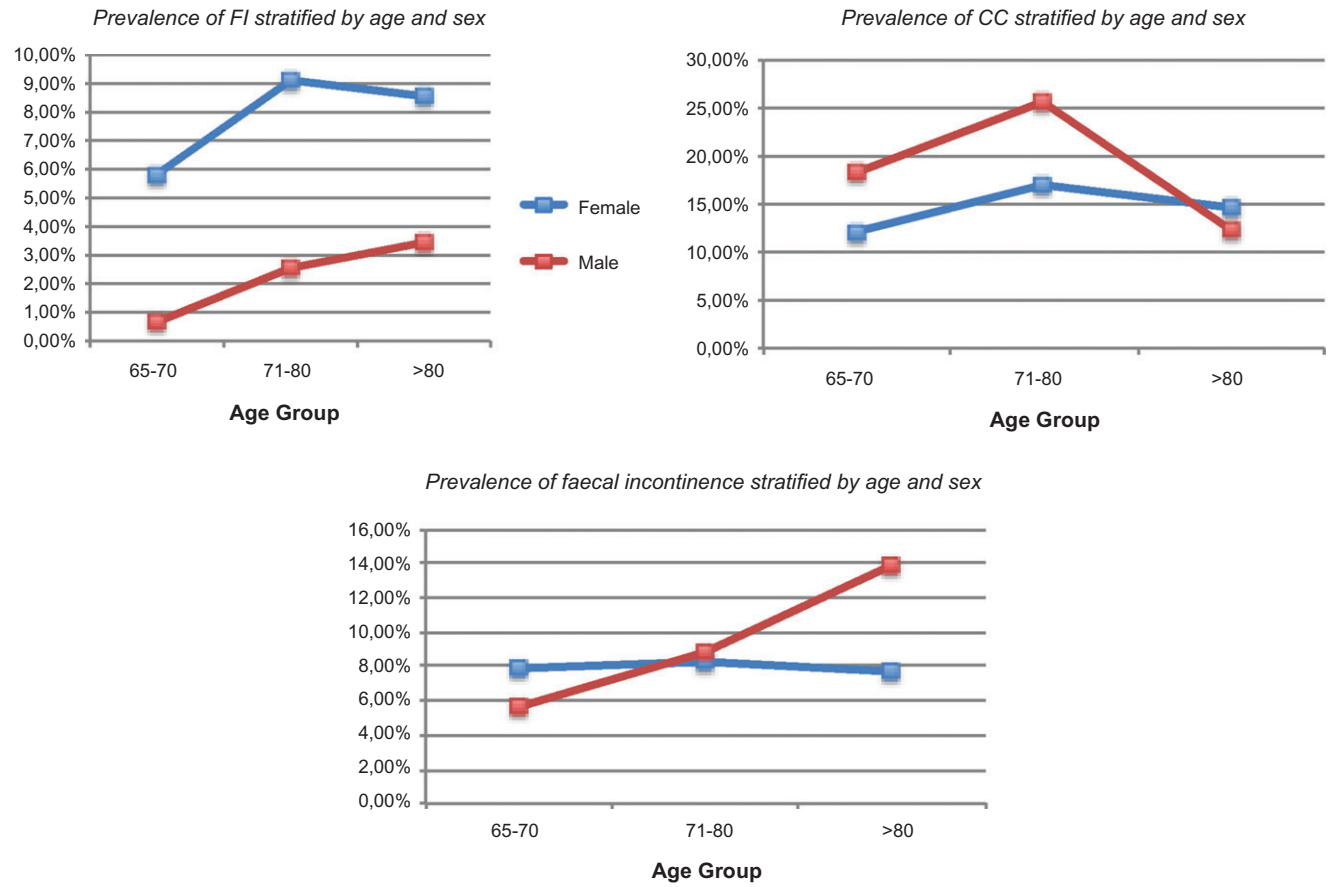

Figure 1. Prevalence of constipation, FI and faecal incontinence in the Spanish old population stratified by age and sex.

followed by herbal laxatives (26.6%), non-absorbable disaccharides (16,1%), diphenolates (10.5%), anthraquinones (9.1%) and polyethylene glycol (2.1%). In addition, 11 people (1.1%, 95% CI: 0.5–1.7%) acknowledged a regular use of suppositories or enemas for constipation.

Associated factors: Female gender (OR 2.1, 95% CI: 1.4–3.2), ex-smoking (OR 2.0, 95% CI: 1.1–3.6) and SSRIs (OR 2.9, 95% CI: 1.6–5.3) emerged as associated factors in the multivariate analysis.

Faecal incontinence and associated factors

Prevalence of faecal incontinence: 82 people suffered from faecal incontinence at least monthly within the past 3 months (8.2%, 95% CI: 6.5–9.9%). Among them, 25 had suffered from faecal incontinence weekly and 41 people less often than monthly, so the overall prevalence of faecal incontinence in the studied population with less restrictive criteria would be 12.5%. Figure 1 shows the prevalence of faecal incontinence stratified by age and sex.

Associated factors: Number of comorbidities (OR 1.5, 95% CI: 1.2–1.9) and number of drugs (OR 1.1, 95% CI: 1.1–2) were associated with faecal incontinence in the multivariate analysis. Fibre consumption, regardless of the amount, emerged as a protective factor. When the variables 'loose stools, more than 4 bowel movements a day and defecatory urgency' were incorporated into the model, diabetes mellitus (OR 2.5, 95% CI: 1.4–4), number of drugs (OR 1.1, 95% CI: 1–1.2) , loose stools (OR 4.3, 95% CI: 2.3–8.3) and defecatory urgency (OR 6.6, 95% CI: 3–14.9) emerged as risk factors. Fibre consumption was also shown as a protective factor.

Relationship between FI, constipation and faecal incontinence

Only three people met criteria for CC, FI and faecal incontinence (0.03%, 95% CI: 0.028–0.032%). The whole distribution of FI, CC and faecal incontinence are shown in Figure 2.

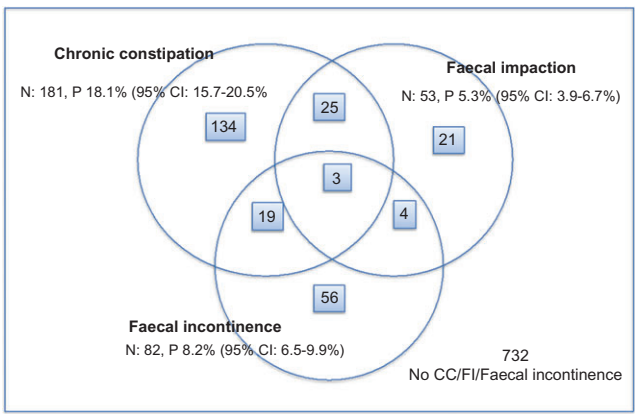

Figure 2. Schematic representation of the distribution of FI, faecal incontinence and CC in the Spanish old population stratified by age and sex.

Discussion

Our study describes for the first time the prevalence of FI and associated factors in community-living old people, as well as its relation with faecal incontinence and CC.

FI is a common problem in the general population older than 65 years living in a community setting, according to our results. Moreover, FI is under-recognised; it is surprising that more than half of FI cases have not visited a doctor. Furthermore, FI has shown to be a recurrent problem (75.3%) that may be explained for a late diagnose and ineffective treatment.

CC has emerged as an independent risk factor for FI, which confirms the hypothesis that FI is associated to CC. Female sex was the only common risk factor for both CC and FI in the multivariate analysis. Woman have a higher risk to develop CC in the elderly, possibly due to social habits, delayed colonic transit time and pelvic floor dysfunction [24]. Moderate physical activity compared to intense physical activity also emerges as a risk factor only for FI.

Interestingly, chronic renal failure (CRF) is as an independent risk factor for FI, but not for CC. Disturbances in fluid volume and electrolyte activity may predispose to impaction, as do the effects of uraemia on the autonomic nervous system. In addition, the use of drugs like calcium preparations can contribute to the risk of impaction [16]. There are several clinical cases reporting FI in patients with CRF and haemodialysis [8]. Further studies are required to confirm this association.

Comorbidities such as neuropsychiatric disease and drugs like anticholinergics or opioids, whose association with FI are known [2] have not emerged as independent factors for FI or CC. It could be explained by an earlier diagnosis and prevention in these cases.

The prevalence of constipation in our study is in accordance with a previous study in the Spanish population, because of the high percentage of regular laxative use [22].

However, the prevalence of faecal incontinence was slightly lower than previously reported [25], even in studies that used the same definition of faecal incontinence [26]. It could be explained by the fact that questionnaires were completed during a medical visit instead of telephone survey.

Symptoms of diarrhoea represent the main risk factor for faecal incontinence in our study, according to the outcome of several studies [27]. Diabetes mellitus emerged as a risk factor when these symptoms were included, in the model. Altered rectal function has been investigated in patients with diabetes mellitus, suggesting that rectal adaptation and motoneuron dysfunction may lead to severe anal sphincter dysfunction [28]. Symptoms of diarrhoea and diabetes should be vigorously assessed in this regard.

Relationship between FI, constipation and faecal incontinence

FI is associated with CC according with our results. However, faecal incontinence is not. Constipation–impaction–incontinence

sequence does not seem to be a common phenomenon in the non-institutionalised population. One limitation in interpreting this fact is the possibility of pseudo-diarrhoea associated with impaction.

Limitations

This is a population-based study whose main objective is to evaluate FI prevalence in community-living old people. Main limitation of our study is that FI prevalence may be under-recognised for some reasons. Firstly, we assessed FI using a questionnaire, instead of physical exploration or imaging techniques. However, the FI questionnaire was previously validated in old people and showed a good correlation with medical diagnosis. Secondly, data collection was made by phone, which may select more independent subjects with fewer comorbidities and a dependence scale was not used; although we did not specifically check this potential source of bias, indirect data suggest the representativeness of our sample, since the use of Statins and PPI are in accordance with Spanish data in 2013 [29] as well as the prevalence of diabetes mellitus previously reported [30].

Conclusions

FI affects around 5% community-living old people, and it is largely unrecognised. Constipation and female gender are its main associated factors. Low physical activity and the number of associated diseases, especially CRF, also play a significant role. The constipation–impaction–incontinence sequence does not seem to be a common phenomenon in the non-institutionalised population. Further studies are required to confirm FI-associated factors and to assess this sequence.

Key points

- FI affects around 5% community-living old people.
- Constipation and female gender are the main risk factors for FI in older people.
- Low physical activity and CRF appear to play a significant role in FI.
- The 'constipation–impaction–incontinence' sequence does not seem to be a common phenomenon in the non-institutionalised population.
- Further studies are required to assess FI-associated factors and confirm these data.

Supplementary data

Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

Funding

This study was supported by an unrestricted grant from Norgine Iberia, who did not participate in the study's design, conduct or reporting.

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Received 5 February 2016; accepted in revised form 4 July 2016

Age and Ageing 2017; **46:** 124–129
doi: 10.1093/ageing/afw163
Published electronically 10 September 2016

Preferences for the emergency department or alternatives for older people in aged care: a discrete choice experiment

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Abstract

Objectives: to estimate the effect of factors that influence decisions to transfer residents of aged care facilities to an emergency department (ED) for acute medical emergencies.
Design and participants: a discrete choice experiment with residents (N = 149), the relatives of residents (N = 137) and staff members (N = 128) of aged care facilities.
Setting: aged care facilities in three Australian states.
Outcome measures: using random parameter logit models, parameter estimates and odds ratios were estimated, and resultant utility functions for ED and alternate care were constructed.
Results: all attributes (including waiting time, complication rates, symptom relief and time spent alone) significantly influence choice for accessing acute care. There is a strong overall preference for ED care (odds ratio 1.73, 95% confidence interval 1.57–1.92), but this varies by clinical scenario, being the strongest for pneumonia and weakest for wrist fracture. Relatives of residents were less tolerant of reductions in care quality than staff members or residents themselves.

DOI: 10.15171/mejdd.2018.94

Original Article 75

Prevalence of Chronic Constipation and Its Associated Factors in Pars Cohort Study: A Study of 9000 Adults in Southern Iran

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Received: 01 Dec. 2017
Accepted: 11 Mar. 2018

ABSTRACT

BACKGROUND

Chronic constipation is one of the most common gastrointestinal disorders. It has negative effects on the patients' quality of life, and their productivity, and results in a high economic burden on the healthcare services. The aim of the present study was to estimate the prevalence of chronic constipation and its associated factors in pars cohort study (PCS).

METHODS

A cross-sectional study was conducted on the baseline data of the PCS. Data gathering was done by structured questionnaire and physical examination. A total of 9264 subjects aged between 40 and 75 years were enrolled in the PCS. Diagnosis of chronic constipation was done using Rome IV criteria. Multivariable binary logistic regression was applied for data analysis.

RESULTS

A total of 752 (8.1%) participants were diagnosed as having chronic constipation (9.3% of female and 6.7% of male participants). Older age (OR: 1.55, 95% CI: 1.31-1.83), physical activity (OR: 0.56, 95% CI: 0.46-0.68), opium consumption (OR: 2.06, 95% CI: 1.63-2.60) , anxiety (OR: 1.38, 95% CI: 1.15-1.65), depression (OR: 1.22, 95% CI: 1.01-1.48), back pain or arthralgia (OR: 1.38, 95% CI: 1.14-1.67), insomnia (OR: 1.62, 95% CI: 1.36-1.93) and gastroesophageal reflux disease (OR: 1.51, 95% CI: 1.28-1.78) were associated with the prevalence of constipation in the multivariable analysis.

CONCLUSION

Chronic constipation was a common problem in the PCS population. Decreasing modifiable risk factors associated with constipation such as opium consumption and physical inactivity can reduce its prevalence and decrease burden of the disease.

KEYWORDS:
Epidemiology, Chronic constipation, Rome IV criteria, Opium, Iran, Risk factors

Please cite this paper as:
Moezi P, Salehi A, Molavi H, Poustchi H, Gandomkar A, Imanieh MH, Malekzadeh R. Prevalence of Chronic Constipation and Its Associated Factors in Pars Cohort Study: A Study of 9000 Adults in Southern Iran. *Middle East J Dig Dis* 2018;**10**:75-83. doi: 10.15171/mejdd.2018.94.

INTRODUCTION

Constipation has been defined as infrequent, difficult (hard consistency or with straining), or incomplete evacuation. Chronic constipation (CC) is one of the most common gastrointestinal disorders. In some populations it is the most common digestive complaint, which leads to a high number of medical visits

and imposes high costs to the healthcare service.[1] Previous studies have reported a wide range of prevalence for CC (2-27% with an average of 15% in most studies).[2,3] This wide range is due to different study populations and also different inclusion criteria, for example studies that reported the prevalence based upon self-reporting, showed higher prevalence compared with those that used Rome criteria [4] or studies conducted in southeast Asia reported lower prevalence compared with American and European studies.[5-7]

Due to these variations in prevalence, most recent studies have used Rome criteria, which are standardized and more expansive consensus criteria for diagnosing functional gastrointestinal disorders. The last version of this criteria is Rome IV that was released in May 2016.[8]

CC has different etiologies. It may be due to secondary causes including metabolic disorders, electrolyte imbalance, neurological disorders, colorectal structural disorder, and use of specific medications.[9] Although only a few patients with chronic constipation have these secondary causes, when dealing with a patient with constipation in practice these causes also should be in consideration. Functional constipation (FC) is the most common form of CC and its diagnosis is made after exclusion of alarm symptoms (significant weight loss, hematochezia or positive occult blood test, anemia, acute constipation, positive family history of colon cancer, etc.) and secondary causes. Patients with FC are categorized into three subgroups based on the pathophysiology; patients with normal colonic transit (NCT), those with slow colonic transit (SCT), and those with functional defecatory disorders. Diagnostic and treatment approaches in these three subgroups are different from each other.[10]

Some of the risk factors for functional constipation based on previous studies are female sex, older age, low socioeconomic status, physical inactivity, and insufficient fluid and fiber consumption.[7,11,12]

CC is a major health problem. It has negative effects on the patients' quality of life, and their productivity, and results in a high economic burden on the healthcare services.[13,14] There are a few studies on the prevalence of chronic constipation in Iran and especially in southern Iran. So we conducted present study to investigate the prevalence of CC and its associated factors in one of the largest cohort studies conducted in the south of Iran in order to provide a baseline data for further future trials.

MATERIALS AND METHODS

Study Subjects and setting

Baseline data of pars cohort study (PCS) were analyzed in cross-sectional design. PCS was launched in 2012 in Valashahr district, a rural area located in southern Iran. Valashahr district has more than 40,000 inhabitants mainly of Fars or Turk ethnicities. A total of 9264 participants aged between 40 to 75 years were enrolled in the study. Data were collected by using a structured questionnaire in addition to physical examination. Further details of the study protocol and preliminary results have been published previously.[15]

Ethical consideration

The study protocol was approved by research committees of both Tehran and Shiraz Universities of Medical Sciences and it is in accordance with the 1964 Helsinki declaration. Informed consent was obtained from all the participants.

Study outcome

CC was measured and then defined according to Rome IV questionnaire and criteria.[16] The participants were categorized as having CC or not. The pattern of independent variables in patients was compared with those who did not have CC.

Variables measurement

In spite of a large number of variables measured in PCS (e.g. more than 180 variables) mostly by self-report and partly by physical examinations and biological samples, a shorter list of variables was selected. Independent variables were selected according to a conceptual framework, in which all potential associated factors of the CC were identified and analyzed according to biological considerations as well as evidence on the determinants of the prevalence of the CC. Accordingly, age, sex, body mass index, systolic and diastolic blood pressure, educational level, socio-economic status, marital status, ethnicity, physical activity, smoking, opium and alcohol consumption, and self-reported medical diseases (heart disease including heart failure, angina and myocardial infarction), stroke, hypertension, diabetes mellitus, liver

disease, chronic kidney disease, chronic obstructive pulmonary disease, anxiety, depression, back pain or arthralgia, insomnia, history of previous surgery, history of previous cancer, and gastroesophageal reflux disease (GERD) were considered as associated factors of the prevalence of the CC.

Data preparation

Body mass index was categorized based on WHO definition into subgroups (e.g. underweight as less than 18.5, normal as 18.5 to 24.9, overweight as 25 to 29.9, and obese as 30 and above.) Ethnicity was categorized into two main groups including Fars and non-Fars (Turk and other minorities). Educational level was classified as illiterate, less than 5 years,[6-12] years, and university degree. Applying multiple correspondence analysis socioeconomic scores were estimated,[17] and then categorized into five quintiles. The value of Metabolic Equivalent of Task (MET) score as a measure of physical activity was calculated applying standard method recommended for analysis of international physical activity questionnaire (IPAQ). MET scores were then categorized into three thirties, hereafter, low, medium, and high physical activity.

In case of cigarette and non-cigarette tobacco and also opium consumption, the participants with at least once per week for the past six months were considered as users. While in case of alcohol consumption, the participants who used once per month for the past 6 months were considered as alcohol users.

Statistical analysis

Data quality was assessed. Univariate and multivariate outliers were identified and handled in an appropriate recommended manner.[18] Internal and external inconsistencies were also identified and handled. Rate and pattern of missing data were analyzed.

Data were described by means and standard deviations and/or frequencies and relative frequencies (for qualitative variables). Independent samples t test or Mann-Whitney U test were used for comparison of quantitative variables and Chi square and/or Fisher's exact test were used for comparison of qualitative variables. Variables with a univariate *p* value of less than 0.1 were retained in the multivariate logistic regression model. Backward likelihood ratio elimination approach was applied for binary multivariate logistic regression. *P* values less than 0.05 were considered as statistically significant. Statistical analyses were done using SPSS software version 23 (SPSS Inc., Chicago, IL, USA).

RESULTS

Overall 9264 participants were enrolled in PCS. Of them 4276 (46.2%) were male and 4988 (53.8%) were female participants, with a mean age of 52.6 ± 9.7 years. A total of 752 (8.1%, 95% CI: 7.6-8.7) participants were diagnosed as having CC. Patients with CC were older than participants without CC (55.7 ± 10.8 vs. 52.4 ± 9.5 years; $p < 0.001$). The prevalence of CC was 9.3% (95% CI: 8.5-10.2) for women, and 6.7% (95% CI: 5.9-7.5) for men (table 1).

The prevalence of the CC among cigarrete ever and never users were 7.8% (95% CI: 6.7-9.2) and 8.2% (95% CI: 7.5-8.8), respectively. The prevalence of CC for participants who had been reported to be illiterate was 9.0% (95% CI: 8.0-10.0) and for other participants was 7.2% (95% CI: 6.5-8.1). Divorced or widow participants had a prevalence of 12.9% (95% CI: 10.5-15.7). The prevalence of CC among participants who aged 60 years and above was estimated at 11.9% (95 % CI: 10.5-13.5) (table 1).

The participant with lower physical activity had a higher prevalence of CC compared with those who were physically more active (10.1%, 95% CI: 9.8-12.1 vs. 5.6%, 95% CI: 4.8-6.5). Estimated prevalence of CC was 9.1% (95% CI: 7.8-10.4) for participants in lower economic level and 6.5% (95% CI: 5.4-7.9) for those who were in higher level. There was no significant relation between body mass index and CC ($p = 0.08$, table 1).

Sex-stratified comparison of smoking, and opium and alcohol consumption was done, which showed cigarette smoking and opium consumption were significantly associated with CC in men (unadjusted OR for opium consumption in men was 2.70 with a 95% CI: 2.09-3.5) (table 2).

Univariate analysis showed that the prevalence of CC was significantly higher in patients with self-reported heart disease ($p < 0.001$), stroke ($p = 0.001$), diabetes mellitus ($P < 0.001$), anxiety ($p < 0.001$), depression ($p < 0.001$), back pain or arthralgia ($p < 0.001$), insomnia ($p < 0.001$), history of previous surgery ($p = 0.001$), and

Table 1: Demographic, anthropometric, and lifestyle characteristics of patients with and/or without chronic constipation

Variables		CC (n = 752)	No CC (n = 8511)	*P* value
Age		55.7 ± 10.8	52.4 ± 9.5	< 0.001
Sex	Female	466 (62%)	4521 (53.1%)	< 0.001
	Male	286 (38%)	3990 (46.9%)	
BMI	Underweight and normal	322(42.9%)	3778 (44.6%)	0.08
	Overweight	269 (35.9%)	3173 (37.5%)	
	Obese	159 (21.2%)	1511 (17.9%)	
Ethnicity	Fars	468 (62.2%)	4748 (55.8%)	0.001
	Non Fars (Turk and others)	284 (37.8%)	3763 (44.2%)	
Marital status	Single	19 (2.5%)	278 (3.3%)	< 0.001
	Married	636 (84.6%)	7575 (89%)	
	Divorced/widow	97 (12.9%)	655 (7.7%)	
Educational level	Illiterate	408 (54.4%)	4130 (48.6%)	0.002
	≤ 5 years	219 (29.9%)	2511 (29.5%)	
	6-12 years	106 (14.1%)	1601 (18.8%)	
	University	17 (2.3%)	264 (3.1%)	
Physical activity	Low	339 (45.1%)	2766 (32.5%)	< 0.001
	Medium	239 (31.8%)	2828 (33.3%)	
	High	174 (23.1%)	2911 (34.2%)	
Wealth score	Quintile 1	197 (26.2%)	1978 (23.2%)	0.024
	Quintile 2	124 (16.5%)	1438 (16.9%)	
	Quintile 3	181 (24.1%)	1823 (21.4%)	
	Quintile 4	136 (18.1%)	1644 (19.3%)	
	Quintile 5	114 (15.2%)	16289 (19.1%)	

P was calculated by: Mann-Whitney U test, X2 test and Fisher exact test
CC: Chronic constipation, BMI: body mass index

Table 2: Sex-stratified comparison of smoking, and opium and alcohol consumption

		Men (n = 4286)			Women (n = 4988)		
Variables		**FC (n = 286)**	**No FC (n = 3990)**	***P* value**	**FC (n = 466)**	**No FC (n = 4521)**	***P* value**
Cigarette ever used	Yes	144 (50.3%)	1745 (43.8%)	0.032	8 (1.7%)	43 (1%)	0.12
	No	142 (49.7%)	2238 (56.2%)		458 (98.3%)	4471 (99%)	
Non-cigarette tobacco ever used	Yes	95 (33.3%)	1136 (28.5%)	0.083	235 (50.4%)	2071 (45.9%)	0.063
	No	190 (66.7%)	2848 (71.5%)		231 (49.6%)	2440 (54.1%)	
Opium ever used	Yes	98 (34.3%)	645 (16.2%)	< 0.001	2 (0.4%)	29 (0.6%)	0.56
	No	188 (65.7%)	3345 (83.8%)		464 (99.6%)	4492 (99.4%)	
Alcohol consumption	Yes	17 (5.9%)	149 (3.7%)	0.062	2 (0.4%)	28 (0.6%)	0.61
	No	269 (94.1%)	3841 (96.3%)		464 (99.6%)	4493 (99.4%)	

P was calculated by: X2 test and fisher exact test
CC: Chronic constipation, FC: Functional constipation

GERD ($p < 0.001$). No association was found between CC and liver disease, chronic kidney disease, chronic obstructive pulmonary disease, and history of previous cancer (table 3).

Older age (OR:1.55, 95% CI:1.31-1.83), physical activity (OR: 0.56, 95% CI: 0.46-0.68), opium consumption (OR: 2.06, 95% CI: 1.63-2.60), anxiety (OR: 1.38, 95% CI: 1.15-1.65), depression (OR: 1.22, 95% CI:

Table 3: Comparison of the history of medical diseases between the patients with and/or without chronic constipation

Variables		CC (n = 752)	No CC (n = 8511)	*P* value
Heart disease	Yes	120 (16%)	841 (9.9%)	< 0.001
	No	632 (84%)	7670 (90.1%)	
Stroke	Yes	25 (3.3%)	141 (1.7%)	0.001
	No	627 (96.7%)	8370 (98.3%)	
HTN	Yes	170 (22.6%)	1343 (15.8%)	< 0.001
	No	582 (77.4%)	7168 (84.2%)	
Diabetes mellitus	Yes	102 (13.6%)	772 (9.1%)	< 0.001
	No	650 (86.4%)	7739 (90.9%)	
Anxiety	Yes	320 (42.6%)	2424 (28.5%)	< 0.001
	No	432 (57.4%)	6087 (71.5%)	
Depression	Yes	223 (29.7%)	1572 (18.5%)	< 0.001
	No	529 (70.3%)	6939 (81.5%)	
Insomnia	Yes	243 (32.3%)	1552 (18.2%)	< 0.001
	No	509 (67.7%)	6959 (81.8%)	
Surgery history	Yes	408 (54.3%)	4052 (47.7%)	0.001
	No	344 (45.7%)	4437 (52.3%)	
Back pain or joint pain	Yes	591 (78.6%)	5702 (67%)	< 0.001
	No	161 (21.4%)	2809 (33%)	
GERD	Yes	271 (36%)	2054 (24.1%)	< 0.001
	No	481 (64%)	6457 (75.9%)	

P was calculated by: X2 test or fisher exact test.
CC: Chronic constipation, HTN: hypertension, GERD: Gastroesophageal reflux disease

1.01-1.48), back pain or arthralgia (OR: 1.38, 95% CI: 1.14-1.67), insomnia (OR: 1.62, 95% CI: 1.36-1.93), and GERD (OR: 1.51, 95% CI: 1.28-1.78) were associated with higher prevalence of constipation in the multivariable analysis (table 4).

DISCUSSION

The prevalence of CC in our study was 8.1% (6.7% in men and 9.3% in women), which was less than the prevalence reported in most studies conducted in western countries. According to a systematic review in North America the prevalence ranged from 1.9% to 27% with an average of 15% in most studies.[2] According to another meta-analysis the pooled prevalence in South America was 18%, and in north and south Europe was 16%, while in the middle eastern and southeast Asian studies were 14% and 11%, respectively.[7]

According to SEPAHAN systematic review, the prevalence of CC ranged from 2.4% to 11.2% in Iran.[19] In a study conducted in Tehran province, 2.4% of general population were diagnosed as having FC based on Rome III criteria.[20] Another study conducted in Isfahan showed that 9.6% of the participants had constipation according to self-reports.[21] Another study conducted in Kerman, showed a prevalence of 9.4%.[22]

The prevalence estimated in our study, like other studies conducted in Iran, was lower than western countries. This can be due to different life style in Iranian population.[20,23] Iranian diet consists of more fibers (vegetable and fruits). Bread and rice is the main food in Iranian diet.[24] Second reason of this lower prevalence may be the style of Iranian toilet. On a normal defecation, relaxation of the puborectalis and external anal sphincter with increased intra-abdominal pressure straighten the anorectal angle and lead in defecation. Due to full flexion of hip in Iranian toilet the anorectal angle is much wider than in European toilet. This wide angle helps complete evacuation.[25] Our study also included individuals between aged between 40 and 75 years and all of them were from a rural district that both the age limitation and population selection can affect the prevalence.

In this study CC was more prevalent among female

Table 4: Logistic regression analysis of factors associated with chronic constipation

Variables		CC (n = 752)	No CC (n = 8511)	*P* value	Odds Ratio (95% CI)	
					Unadjusted	Adjusted
Opium used	Yes	100 (13.3%)	674 (7.9%)	< 0.001	1.78 (1.42-2.23)	2.06 (1.63-2.60)
	No	652 (86.7%)	7837 (92.1%)		reference	reference
Physical activity	Low	339 (45.1%)	2766 (32.5%)	< 0.001	reference	reference
	Medium	239 (31.8%)	2828 (33.3%)		0.70 (0.58 - 0.82)	0.74 (0.62 - 0.89)
	High	174 (23.1%)	2911 (34.2%)		0.48 (0.40 - 0.59)	0.56 (0.46 - 0.68)
Insomnia	Yes	243 (32.3%)	1552 (18.2%)	< 0.001	2.14 (1.82 - 2.52)	1.62 (1.36 - 1.93)
	No	509 (67.7%)	6959 (81.8%)		reference	reference
Anxiety	Yes	320 (42.6%)	2424 (28.5%)	< 0.001	1.86 (1.60 - 2.17)	1.38 (1.15 - 1.65)
	No	432 (57.4%)	6087 (71.5%)		reference	reference
Depression	Yes	223(29.7%)	1572 (18.5%)	< 0.001	1.86 (1.58 - 2.2)	1.22 (1.01 - 1.48)
	No	529 (70.3%)	6939 (81.5%)		reference	reference
Back pain or joint pain	Yes	591(78.6%)	5702 (67%)	< 0.001	1.80 (1.51 - 2.17)	1.38 (1.14 - 1.67)
	No	161 (21.4%)	2809 (33%)		reference	reference
GERD	Yes	271 (36%)	2054 (24.1%)	< 0.001	1.77 (1.51 - 2.07)	1.51 (1.28 - 1.78)
	No	481 (64%)	6457 (75.9%)		reference	reference
Age	40 – 59 years	486 (64.6%)	6546 (76.9%)	< 0.001	reference	reference
	≥ 60 years	266 (35.4%)	1962 (23.1%)		1.83 (1.56 - 2.14)	1.55 (1.31 - 1.83)

CC: Chronic constipation, GERD: Gastroesophageal reflux disease

sex (female: male ratio = 1.44). Most of previous studies reported higher prevalence of CC among women. Based on a systematic review in North America, the female: male ratio was 2.2 in average.[2] Another systematic review reported a female to male ratio of 2.1, worldwide.[26] In previous studies conducted in Iran the female to male ratio ranged from 1.5 to 3.8.[20-22,27,28] Female sex hormones can be contributed to this higher prevalence. Progesterone can prolong colonic transit time and this can lead to higher rate of constipation in luteal phase of menstrual cycle.[29] A study showed that overexpression of progesterone receptors can lead to slow transit CC in women.[30] Women are also more susceptible to pelvic floor injury due to obstetric trauma during childbirth, which may contribute to CC. According to a study, the prevalence of pelvic floor injury was significantly higher in individuals with constipation, however the cause or effect association was not established well yet.[31]

In our study the prevalence of CC increased with age. This association was confirmed in most previous studies.[13,23,26,32] This may be due to higher rate of co-morbidities in elderly. Diabetes mellitus, hypothyroidism, chronic renal failure, cerebrovascular accident, etc. are some of these co-morbidities that can cause secondary CC.[10] Another cause for higher prevalence of constipation in elderly may be lower energy intake and lower physical activity.[20,33]

There is also a positive association between physical activity and CC in our study. The rate of CC decreased to half in individuals with higher physical activity compared with physically inactive participants. Physical activity can increase propulsive movements in the large intestine.[33,34] Hormonal change during exercise may also affect gastrointestinal (GI) motility.[35]

One of the most important factors that was associated with constipation in our study was opium consumption. The prevalence of constipation was higher among opium addicted men in our study and after adjusting for other variables, it was seen that opium consumption can cause a two fold increase in the prevalence of constipation. Although it is traditionally not consistent with the definition of functional GI disorder, a term known as "Opioid-Induced Constipation" or OIC was added to the recent version of Rome criteria because it can present with similar symptoms as FC.[8,36] Opioids have three different receptors in body (δ, κ, and μ receptors). μ -receptors

are widely distributed in the GI tract and their activation leads to decrease in GI propulsive and peristaltic motility, increase in non-propulsive GI motility, stimulation of ileocecal sphincter, and increase in anal sphincter tone. Activation of opioids receptors also decreases water and electrolyte secretions into GI lumen and increases fluid reabsorption from the gut. Slowing the intestinal transit is another factor that leads to more fluid reabsorption and makes the stool harder. All of these changes can cause or exacerbate constipation.[37]

Our study showed that the prevalence of insomnia was higher in individuals with constipation. A study on Chinese women aged over 50 years showed that poor sleep quality increased the chance of constipation up to three times.[38]

Positive associations of anxiety and depression with the prevalence of constipation were observed in our study. Previous studies showed an association between CC and some psychological disorders such as anxiety or depression.[22,39-41] Antidepressant drugs such as Tricyclic Antidepressant (TCAs) can increase constipation. The underlying mechanism for psychological disorders have not been fully understood yet but it is believed that these disorders can influence gut-brain interaction and cause change in GI motility.[42]

In our study, frequent GERD was more prevalent in patients with constipation. In a study by Baran and colleagues, the overlap of GERD and functional constipation was investigated in children. It was seen that in children suffered from both GERD and FC, treatment of constipation led to a significant improvement in GERD symptoms.[43] Another study in Korean patients reported that the overlap of GERD or functional dyspepsia was common in patients with constipation.[44]

The strength of our study is its large sample size and involvement of multiple variables that were available based on PCS questionnaire. We investigated the association between opium consumption and constipation in a large sample size. Limitations of our study are its cross-sectional design and age restriction from 40 to 75 years. Accordingly, the study may not be fully able to explain the cause-effect associations.

In conclusion, the overall prevalence of constipation is 8.1% in our population. The most important factors that were associated with constipation in our study were older age, physical inactivity, opium consumption, anxiety, depression, insomnia, back pain or arthralgia, and GERD. Decreasing modifiable risk factors associated with constipation such as opium consumption and physical inactivity can reduce its prevalence and decrease the burden of the disease.

ETHICAL APPROVAL

There is nothing to be declared.

CONFLICT OF INTEREST

The authors declare no conflict of interest related to this work.

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Pak J Med Res
Vol. 57, No. 1, 2018

Original Article

Prevalence of Irritable Bowel Syndrome and it's Risk Factors Among Medical Students of Peshawar, Pakistan

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Abstract

Background: Irritable bowel syndrome is a disorder of gastrointestinal tract that is related to psychological dysfunction and is effected by the social, environmental and psychological factors. This study focuses on the various aspects of prevalence, risk factors and outcomes of the irritable bowel syndrome in medical college students
Objectives: To study the prevalence and risk factors of irritable bowel syndrome among medical students of Peshawar, Pakistan.
Study design, settings and duration: A cross-sectional study was conducted in Khyber Medical College, Khyber Girls Medical College, Rehman Medical College, Peshawar Medical College, Peshawar from January 2017 to June 2017.
Subjects and Methods: A sample size of about 552 medical students were taken by using WHO sample size calculator using 95% confidence interval and 5% margin of error through simple random sampling technique. Data was collected by administering a semi structured questionnaire and analyzed using SPSS version 20.
Results: The prevalence of IBS was 13.4% in males and 17.5% in females. IBS was positively associated with factors like stress and sleep disturbance and negatively associated with risk factors like exercise, smoking, living standards, household income and spicy food.
Conclusion: Keeping in view of high occurrence of IBS among medical colleges and university students, there is need to aware the students from the possible negative outcomes of this condition.
Key words: Irritable bowel syndrome, stress, risk factors.

Introduction

Irritable bowel syndrome (IBS) is a disorder of Gastrointestinal tract that is related to psychological dysfunction and is influenced by various factors including stress, change of environment and sleep pattern.[1,2] IBS has a greater effect on individual's daily life activities and leads to increase cost and absenteeism from work.[3,4]

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Received: 03 December 2017, **Accepted:** 05 March 2018,
Published: 22 March 2018

Authors Contribution

BI has done the conceptualization of project. K did the data collection and literature search was done by HR. KRK did the Statistical analysis. HN has done the drafting, revision and writing of the manuscript.

The etiology of IBS is not yet confirmed. Various theories are proposed by different researchers that includes irritation of intestinal lumen by certain food, stress, depression and post infections etc. Abnormal visceral perception have been proposed as the primary mechanism for IBS in recent times.[5,6]

It is also thought that increased sensitivity of the gut due to altered neurotransmitters and signals may play a role. Due to such signals even mild pain in normal individuals becomes severe in people having IBS. Some researchers suggests that psychological factors play an important role in IBS. Early child hood events are also having profound effects on children. Child abuse, neglect or other medical condition leads to stress and finally IBS.[7]

The incidence of IBS is about 1-2 % per year and Prevalence varies between 10-20% per year according to different studies.[8,9] Approximately 10-20% of people with IBS seek medical care and an estimated 20-50% of referrals to gastrointestinal wards are related to IBS symptoms.[10] The prevalence of IBS in Canada is about 6%,[11] Japan

10% (2006),[12] UK 10.5% (2004),[13] US 14.1% (2005),[14] Pakistan 14% (2007),[15] Pakistan 34% (2005 in college students).[16]

Females are about two to three times more prone to IBS as compared to males.[17] Quality of life and psychological factors in females leads to high prevalence of IBS in female gender.[18] Gender differences in healthcare-seeking may also play a role. IBS symptoms usually starts before the age of age of 35 years. Symptoms of IBS are very rare above 40 but it does not exclude IBS and underlying etiology must be searched.[19]

Symptoms of IBS are also initiated by using various food and drinks e.g carbonated beverages, chocolate, tea, coffee, processed food and fried food.[20] Some experts think small intestinal bacteria overgrowth may lead to IBS. Researchers continue to explore a possible link between the two conditions. It is also stated that IBS is more common in people with family members who have a history of GI problems.[21]

The disease requires special attention regarding evidence based research. This study focuses on the various aspects of prevalence, risk factors and outcomes of the IBS in medical college students. The study might prove to be useful in further studies for assessing the environmental and climatic factors and might be further used to create awareness among the general public of Peshawar as well as medical practitioners. The study may also be helpful in diverting the attention of the families of disease stricken patients to improve health and life-style of IBS patients in order to have a better outcome of the treatments being taken.

Subjects and Methods

A cross-sectional study was conducted from January 2017 to June 2017. A sample size of 552 students aged 18-25 years were taken using Who sample size calculator and taking 95 Confidence interval and 5% margin of error. Students were selected from Khyber Medical College, Khyber Girls Medical College, Rehman Medical College, Peshawar Medical College and using simple random sampling technique. Standardized measuring scales/questionnaires were used to determine IBS and its related factors. ROME III criteria was used to determine IBS. Mild Moderate and severe stress depression and anxiety were assessed using DASS [21] (Depression, anxiety and stress scale) and quality of sleep was determined using Pittsburgh Sleep Quality Index (PSQI). Ethical clearance was obtained from ethical review board Khyber medical college. After taking informed consent data was collected using standardized questionnaire. Data was analyzed using SPSS version 20 for windows.

Results

Among 552 medical students, 74 were having IBS, the prevalence of IBS was 13.4%, in males, 17.5% in females, 7.3% (16/74) of the students were found to be positive for IBS symptoms. Gender stress and sleep pattern were significantly associated with IBS as *p*-value was less than 0.05 (Table).

The association of IBS disorder with stress was determined by categorizing the data into three degrees of stress severe/high, moderate and average/low. Analyses were carried out on 552 students, out of which 156 students (28.3%) fulfilled the criteria of having severe/high degree of stress, out of which 21.8% (34/74) of the cases were positive for IBS. Out of 336 students (60.9%) were diagnosed with moderate degree of stress, out of which 10.7% (36/74) of the cases were positive for IBS.60 students (10.9 %) suffered from low level of stress, out of which 6.7% (4/74) of the cases were positive for IBS. The results of our study shows that stress is a significant risk factor of IBS, the chi-square statistics is 13.902,with the *p*-value of 0.001, the result is significant at (p <0.05), associated with an odds ratio of 3.90 (99 % CI) .

The relation of IBS disorder was also found to be significant with sleep disturbances. A standard criterion for determination of sleep quality was followed. Analyses were carried out on 552 students, out of which 360 students (65.2%) were having good quality of sleep, out of which 10.6% (38/74) of the cases were positive for IBS. Among 118 students (21.4%) with fair degree of sleep, 20.3% (24/74) were diagnosed to have IBS.74 students (13.4%) with poor quality of sleep, out of which 16.2% (12/74) of the cases were positive for IBS. The result of our analyses shows the chi-square statistic is 7.909. The *p*-value is .019. The result is significant at $p < .05$, associated with an odds ratio of 2.16 (95 % CI).

The association of IBS disorder was found to be not significant with risk factors like exercise, smoking, living standards, household income and spicy food as clear from *p*-value.

Discussion

IBS is a medical condition that affects work performance of individual especially students. In present study out of 552 students, 74 students (13.4%) were positive for IBS. The age of the students ranged from 19 to 25 years. Gender can also be a risk factor for IBS. Results of our study

Table: Risk Factors for irritable bowel syndrome.

Variable	*Total n = (552) n (%)*	*IBS n=74 (13.4%) n (%)*	*Non-IBS n = 478 (86.6%) n (%)*	*p-value*	*Chi Square Value*	*Odd-Ratio*
Gender						
Female	332 (60)	58 (17.5)	274 (82.5)	0.001	11.852	2.69
Male	220 (40)	16 (7.3)	204 (92.7)			1.00
Stress/depression						
High	156 (28.3)	34 (21.8)	122 (78.2)	0.001	13.902	3.90
Moderate	336 (60.9)	36 (10.7)	300 (89.3)			1.68
Average/Low	60 (10.9)	4 (6.7)	56 (93.3)			1.00
Sleep						
Good	360 (65.2)	38 (10.6)	322 (89.4)			1.00
Fair	118 (21.4)	24 (20.3)	94 (79.7)	0.019	7.909	2.16
Poor	74 (13.4)	12 (16.2)	62 (83.8)			1.64
Exercise						
Not At All	246 (44.6)	38 (15.4)	208 (84.6)			1.00
2-3 Days/Week	200 (36.2)	22 (11)	178 (89)	0.390	1.884	0.67
4 Or More Days/Week	106 (19.2)	14 (13.2)	92 (86.8)			0.83
Smoking						
Yes	60 (11)	8 (13.3)	52 (86.7)	0.986	0.000	0.99
No	492 (89)	66 (13.4)	426 (86.6)			1.00
Living with						
Hostel	210 (38)	28 (13.3)	182 (86.7)	0.969	0.002	0.99
Home	342 (62)	46 (13.5)	296 (86.5)			1.00
Income						
5-20,000	50 (9.1)	10 (20)	40 (80)			1.00
21-50,000	110 (19.9)	14 (12.7)	96 (87.3)	0.524	2.243	0.58
51-100,000	224 (40.6)	30 (13.4)	194 (86.6)			0.62
>100,000	168 (30.4)	20 (11.9)	148 (88.1)			0.54
Spicy food						
Seldom	192 (34.8)	20 (10.4)	172 (89.6)			1.00
2-4 D/Week	204 (37)	26 (12.7)	178 (87.3)	0.115	4.328	1.26
>4 D/Week	156 (28.3)	28 (17.9)	128 (82.1)			1.88

showed higher prevalence of IBS in female students as compared to male. Liu et al conducted a similar study in Beijing University of Chinese Medicine. Symptoms of IBS were present in 36.3% females and 25% males, showing an agreement to our study results.[22] Another study conducted on medical students of Karachi, Pakistan also showed increase prevalence of IBS in female students.[23] Another study done by Yan-Mei Tan et al. also showed high prevalence of that IBS among female medical students.[23] Lei Shan et al. also showed that the prevalence of IBS among Chinese university students was 14.5% in males and 16.8% in female. Another study conducted in Lebanon also showed that females are having symptoms of IBS more as compared to male students.[24]

Medical students are prone to IBS due to stressful routine of the examinations and tests. In addition, females are more likely to have hormonal problems and sleep disorders that leads to stress and depression, which may be related to the high prevalence of IBS in them. Results of present study showed that students having severe (21.8%) and moderate (10.7%) degree of depression has higher prevalence of IBS this shows that depression may be a significant risk factor of IBS. The co-morbidity of IBS and psychological distress is common, and the prevalence of at least one psychiatric illness ranged from 40% to 60% and has been reported as high as 80%.[20,21] Association of IBS with mental disorders were also found by Amna et al in a study done at Agha Khan University Hospital Karachi. Results should that IBS was more common in subjects having mental disorders like depression.[25]

Association of IBS disorder with sleep disorder was also found to be significant in our study. Results of our study suggests that students with fair (20.3%) or poor (16.2%) quality of sleep were found to be affected more with this disorder. A cross-sectional study in Beijing University of Chinese Medicine, in which according to the PSQI (physical quality of sleep index) score the severe sleep disorder was present in about 35.5% of students that were suffering from IBS. Another study done in China also showed increase symptoms of IBS in middle school students that have some sort of sleep disorders or poor quality of sleep.[26] The present study showed that total score of the

physical quality of sleep was higher in students with IBS. The prevalence of severe sleep disorder was (20.3%) in students suffering from IBS .Poor sleep is considered as a major risk factor that leads to increase symptoms of IBS.[27,28] A study done by Nasir Kokhar in Shifa International Hospital Pakistan also showed that symptoms of IBS are exacerbated due to poor sleep pattern.[29]

Spicy and fatty food consumption is also considered as a risk factor for developing or exacerbating IBS but the relationship between dietary factors and irritable bowel syndrome (IBS) needs to be further explored.[29] A cross-sectional study done in Iran showed that those people who were consuming spicy food were most commonly developed the symptoms of IBS.[30] In contrast to this our study showed no such results.

IBS symptoms were also correlated with environmental factors like living in hostel but no significant difference in results were found. However in contrast to these findings, a study conducted in Lebanon showed that IBS was more common in students that were living in hostel as compared to those living with their families.[31]

Previous studies also showed high prevalence of IBS in students that do not exercise regularly[32] but no significant association of IBS with exercise was found in our study. Similarly, Dong et al also found high prevalence of IBS among Chinese university students that were not physically active.[33] Increased physical activity therefore has been shown to improve IBS symptoms.

Irritable bowel syndrome was common in medical students .common risk factors identified in present study were stress and lack of proper sleep. Students need to be aware about possible risk factors and proper counselling to combat the particular risk factors that aggravates IBS symptoms.

Conflict of interest: None declared.

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Scandinavian Journal of Gastroenterology

ISSN: 0036-5521 (Print) 1502-7708 (Online) Journal homepage: https://www.tandfonline.com/loi/igas20

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To cite this article: Ruitong Gao, Yujia Tao, Changli Zhou, Jinwei Li, Xige Wang, Lei Chen, Feng Li & Lirong Guo (2019) Exercise therapy in patients with constipation: a systematic review and meta-analysis of randomized controlled trials, Scandinavian Journal of Gastroenterology, 54:2, 169-177, DOI: 10.1080/00365521.2019.1568544

To link to this article: https://doi.org/10.1080/00365521.2019.1568544

SCANDINAVIAN JOURNAL OF GASTROENTEROLOGY
2019, VOL. 54, NO. 2, 169–177
https://doi.org/10.1080/00365521.2019.1568544

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REVIEW

Exercise therapy in patients with constipation: a systematic review and meta-analysis of randomized controlled trials

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ABSTRACT

Background: Exercise therapy has shown significant efficacy as a means of treating various intestinal diseases, but its role in the treatment of constipation is still unclear. The purpose of this study was thus to analyze the effects of exercise on constipation by means of a systematic review and meta-analysis.

Methods: PubMed, Web of Science, EMBASE, Cochrane Library and three Chinese databases [Wanfang Database, Chinese Biomedical Literature (CBM) and China National Knowledge Infrastructure (CNKI)] were searched for relevant studies published through June 2018. Eligible studies were selected in accordance with the PRISMA statement. The main results of interest were changes in gastrointestinal symptoms.

Results: A total of nine randomized controlled trials involving 680 participants were included. Eight studies involved aerobic exercise and only one study involved anaerobic exercise. The aerobic exercises included were Qigong, walking and physical movement. The results of this systematic review and meta-analysis indicated that exercise had significant benefits as a means of improving the symptoms of constipation patients [relative risk (RR) = 1.97; 95% CI: 1.19, 3.27; $p = .009$; I^2=91.3%]. Subgroup analyses showed that aerobic exercise (RR = 2.42; 95% CI: 1.34, 4.36; $p = .000$; I^2=88%) similarly had a positive effect on constipation. However, these results were associated with a high risk of bias.

Conclusion: Our results suggest that exercise may be a feasible and effective treatment option for patients with constipation. However, due to methodological shortcomings, the real effect of this intervention cannot be definitively determined. Researchers should, therefore, design more rigorous studies in order to evaluate the effect of exercise on constipation.

ARTICLE HISTORY
Received 15 October 2018
Revised 29 December 2018
Accepted 5 January 2019

KEYWORDS
Exercise; constipation; randomized controlled trials; systematic review; meta-analysis

Introduction

Constipation, as a functional bowel disorder, is one of the most common chronic gastrointestinal diseases, affecting between 0.7% and 29.6% of people in developed and developing countries [1]. These rates change over time in a manner generally associated with lifestyle changes [2], with aging in particular associated with increased constipation [3]. The prevalence of chronic constipation in women is significantly higher than in men, with a ratio of men: women ranging from 1:1.22 to 1:4.56 [4–6].

Although not a direct threat to life, chronic constipation can significantly degrade overall quality of life [7]. It can lead to sleep disorders [8], anxiety, depression and other psychological problems, and can even increase the mortality associated with hypertension, cardiovascular and cerebrovascular diseases, and the incidence of colon cancer [9,10]. Constipation has thus become a common public health problem across the world with a significant medical, social and economic impact. Many treatments for constipation are available, including drugs, lifestyle changes (e.g., a balanced diet, increased fluid intake and good bowel habits), acupuncture [11], electro-acupuncture [12,13], biofeedback [14] and surgery [15]. Because the etiology and mechanism for constipation are complicated, many of the currently available treatments are not effective for many individuals.

There has been a recent increase in focus on the effect of exercise therapy on constipation, with researchers proposing that exercise programs or enhancements in habitual physical activity may decrease constipation complaints in patients. A Spanish survey [16] revealed that low physical activity appeared to play a significant role in fecal impaction. A cohort of 62,036 women surveyed as part of the Nurses' Health Study [17] revealed that moderate physical activity was associated with a decreased constipation risk. However, some studies have shown that exercise can improve the quality of life for those adults affected by constipation, but that it cannot alleviate the symptoms of this disorder [18]. Similarly, some studies have found no link between regular aerobic exercise and gastrointestinal transit time [19]. The relationship between physical exercise and constipation is

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thus unclear, with key uncertainties with regard to whether exercise can improve constipation, and if so whether certain forms, durations, or intensities of exercise are better able to do so. Given these uncertainties, we performed this systematic review and meta-analysis aimed at analyzing the effects of exercise interventions on constipation in affected patients.

Methods

Search strategy

We searched for eligible studies published through June 2018 in the following databases: PubMed, Web of Science, Embase, the Cochrane Library, the Wanfang Database, Chinese Biomedical Literature (CBM) and China National Knowledge Infrastructure (CNKI). Search terms for physical activity included: 'Exercise' or 'Physical activity' or 'Aerobic exercise' or 'Sports' or 'Exercise Training' or 'Resistance Training' or 'Acute Exercise' or 'Exercise Therapy' or 'Physical Exercises' or 'Muscle Stretching Exercise' or 'Swimming' or 'Walking' or 'Cycling' or 'Yoga' or 'Tai Chi' or 'Qigong' or 'Jogging' or 'Running', and these terms were combined with 'Constipation'.

Study selection

Study inclusion criteria were as follows: 1) randomized controlled trial studies published as a complete manuscript; 2) study participants were adults (≥18 years), diagnosed with non-drug or other disease-induced constipation; 3) the patients were able to exercise without assistance; 4) time and type of exercise interventions were described in detail. Exclusion criteria were as follows: 1) Patients with mental illnesses or cognitive disorders; 2) Women who were pregnant or recently gave birth.

Endnote X 7.0 was used to manage the search results, and duplicate records were removed. Two investigators then independently assessed articles using pre-designed eligibility forms, and in cases of disagreement, a third party served to arbitrate and resolve study eligibility. Irrelevant records were deleted by screening titles and abstracts. Further articles were then identified by reviewing the references of included studies. This systematic review and meta-analysis were conducted according to the PRISMA guidelines.

Quality assessment

The two investigators assessed the risk of bias of the included studies according to the Cochrane Collaboration's tool [20], using the terms 'low risk', 'high risk' and 'unclear risk' to categorize risk of bias, which was analyzed using the Review Manager 5.3 software (Nordic Cochrane Center, Copenhagen, Denmark).

Data extraction and statistical analyses

The following data were extracted from studies: first author, year of publication, case nationality, age, population, sample size, type and frequency of exercise, measurements and outcomes. The data extraction and entry were completed by two investigators independently, and in cases of disagreement, a third party resolved any uncertainties. The effect sizes were expressed as an odds ratio or relative risk (RR) with corresponding 95% confidence interval (CI). Heterogeneity among studies was analyzed using the I^2 statistic. Studies with an $I^2 > 50\%$ were considered to be of high heterogeneity [21], indicating the need for use of a random-effects model for meta-analysis [22]. If $I^2 < 50\%$, a fixed-effects model was instead used. When heterogeneity existed, subgroup analyses were performed to identify sources of heterogeneity. If sufficient studies were available, potential publication bias was assessed using funnel plots [23]. All statistical analyses were performed using Stata v12.0 (Stata Corp., College Station, TX).

Results

Search results and studies characteristics

A total of 3345 studies were identified in our initial database search. Ultimately, nine randomized controlled trials met the inclusion criteria were included in the present systematic review and meta-analysis. The selection process is detailed in Figure 1. A total number of 680 participants from these 9 studies met our eligibility criteria and were included in this systematic review and meta-analysis [24–32]. Among these studies, eight involved aerobic exercise [24–29,31,32], while one involved anaerobic exercise [30]. Forms of aerobic exercise primarily included Qigong [25,28], walking [24,26,29,31,32] and physical movement [27], while the only tested form of anaerobic exercise was resistance training [30]. Detailed characteristics of these studies are provided in Table 1.

Quality assessment

Based on random sequence generation, only one study [28] in which the participants were randomly assigned based on an odd–even approach, was deemed to be of high risk, while six studies [25–27,29,30,32] were of low risk. None of these studies [24–32] described their methods for the allocation concealment, and thus all were of unclear risk of bias. Two

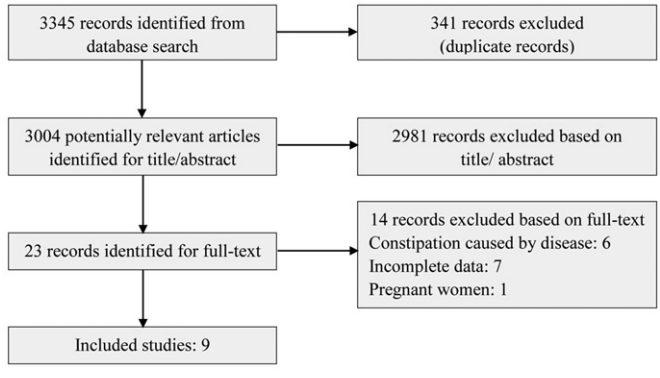

Figure 1. Literature search strategy.

Table 1. Characteristics of studies included in this systematic review and meta-analysis.

Article	Publication Year	Country	Age/years (mean age/age range)	Sample (IG/CG)	Type/frequency of intervention (IG)	(CG)	Program duration	Measurements	Results
Tantawy et al. [24]	2017	Egypt	IG: 33.25 ± 5.23 CG: 34.75 ± 4.43	62/63	Walking, 60 min, 3/ week Total: 180 min/week	Usual care	12 weeks	PAC-SYM PAC-QOL SF-36	IG showed greater improvement in the PAC-SYM, PAC-QOL and quality of life
Zhou et al. [25]	2015	China	42 ± 6.8	17/17	24-Pattern Shadowboxing, 60 min, 3/week Total: 180 min/week	Usual care	12 weeks	Two or more of the following complaints: straining, lumpy or hard stools, feeling of incomplete evacuation, fewer than three bowel movements in a week	IG showed improvement of gastrointestinal functions
Yi et al. [26]	2014	China	IG: 68 CG: 66	35/35	Walking: 9000 step/day	Maziren pills	4 weeks	Straining, lumpy or hard stools, feeling of incomplete evacuation, fewer than three bowel movements in a week	IG had a higher total effective rate than the controls
Jing et al. [27]	2014	China	74. 96 ± 7. 07	38/37	Physical movement, 40–60 min, 7/week Total: 280–420 min/week	Usual care	8 weeks	Chronic functional constipation severity rating scale MUNSH	Symptoms of constipation, general well-being, PA, NA, PE and NE were significantly improved in IG ($p<.01$)
Ma et al. [28]	2011	China	45–55	43/40	Baduanjin, 60 min, 5/ week Total: 300 min/week	Usual care	12 weeks	Rome II SF-36	Significant improve the symptoms of constipation, BP, GH, VT, RE and MH of IG ($p<.05$)
John et al. [29]	2010	USA	IG: 85.84 ± 9.42 CG:86.15 ± 10.46	58/54	Exercise (repeat sit-to-stands and walking or wheelchair propulsion) 20 min, 5/ week Total: 100 min/week	Usual care	12 weeks	Fewer than three bowel movements in a seven-day period	Fewer intervention subjects meeting constipation criterion (Pr = 0.000)
Chin A Paw et al. [30]	2006	Netherlands	IG: 81.3 ± 5.7 CG: 81.3 ± 4.4	41/35	Resistance training: 40–60 min, 2/week Total: 80–120 min/week	Educational program: 45–60 min, 2/week	24 weeks	Not taking laxatives and had two or more of the following complaints: straining, lumpy or hard stools, feeling of incomplete evacuation, fewer than three bowel movements in a week	Neither of the exercise programs had an effect on the percentage of subjects with constipation or taking laxatives

(*continued*)

Table 1. Continued.

Article	Publication Year	Country	Age/years (mean age/age range)	Sample (IG/CG)	Type/frequency of intervention (IG) (CG)	Program duration	Measurements	Results
De Schryver et al. [31]	2005	Netherlands	IG: 59.09 ± 1.9 CG: 53.79 ± 2.1	25/18	Brisk walking: 30 min, ≥2/week Total: 60 min/week Normal lifestyle	12 weeks	Rome I	In IG, the number meeting Rome criteria or constipation decreased significantly ($p<.001$)
Wu et al. [32]	2000	China	IG: 48 ± 16.0 CG: 47 ± 15.1	32/30	Walking, 20–30 min, 7/week Total: 140–210 min/week Auricular acupuncture	30 days	Straining, lumpy or hard stools, feeling of incomplete evacuation, fewer than three bowel movements in a week	The efficacy of the IG was better than that of the CG, after 30 days of intervention and 12 months of follow-up

BP: bodily pain; CG: control group; GH: general health; IG: intervention group; MH: mental health; MUNSH: Memorial University of Newfoundland Scale of Happiness; NA: negative affection; NE: negative experience; PA: positive affection; PAC-QOL: The Patient Assessment of Constipation Quality of Life; PAC-SYM: The Patient Assessment of Constipation-Symptom; PE: positive experience; PF: physical functioning; RE: role-emotional; SF-36: The Short Form-36; VT: vitality.

studies [25,27] showed a low risk of performance bias, while three studies [28–30] showed a low risk of detection bias. All studies [24–32] were low risk with respect to attribution bias and reporting bias. The other potential risks of bias in these studies were unclear [24–32]. The risk of bias of the included trials is summarized in Figures 2 and 3.

Outcomes

The effects of aerobic exercise and anaerobic exercise on constipation

When we chose RR to assess effect size, a total of seven articles were included in this meta-analysis [25,26,28–32], with 351 patients in the intervention group and 329 in the control group. Compared with usual care [25,28,29], normal lifestyle [31], education [30], Maziren pills [26], and auricular acupuncture [32], the overall effect of exercise on constipation was significant (RR = 1.97; 95% CI: 1.19, 3.27; $p = .009$). But there was great heterogeneity among studies (I^2=91.3%). In the eight studies involving aerobic exercise [24–29,31,32], RR could be calculated in six of these [25,26,28,29,31,32], while symptom scores were used in the other two articles [24,27] which were not included in this meta-analysis as a result. The results of the included studies showed that aerobic exercise significantly improved symptoms of constipation (RR = 2.42; 95% CI: 1.34, 4.36; $p = .003$), but there was great heterogeneity among studies ($I^2 = 88.0\%$). Only one study [30] involved anaerobic exercise, and this study showed that twice-weekly resistance training exercise programs lasting for six months affected neither habitual physical activity nor constipation in inhabitants of long-term care facilities. A forest plot of included studies is shown in Figure 4.

Among the included studies, intervention durations ranged from 60 min to 420 min per week. Of the aerobic exercise studies, the two studies performing Qigong interventions lasted 180–300 min per week [25,28], while the five walking intervention studies lasted 60–210 min [24,26,29,31,32], and the one study involving physical movement intervention lasted 280–420 min [27]. In the study of anaerobic exercise, resistance training was performed twice a week lasting 80–120 min per week [30].

Effects of different types of aerobic exercise on constipation

Effects of Qigong on constipation. There were two studies involving Qigong [25,28], and the results of these studies showed that 12 weeks of Qigong significantly improved the symptoms of constipation in the intervention group as compared to the control group undergoing usual care (RR = 3.20; 95% CI: 1.88, 5.44; $p = .000$). There was no heterogeneity among these studies (I^2=0%, $p = .520$) (shown in Figure 5). Furthermore, after intervention for 12 weeks with Baduanjin, the five dimensions of quality of life (bodily pain, general health, vitality, role-emotional and mental health) were significantly improved in the intervention group compared with the control group undergoing usual care ($p < .05$) [28].

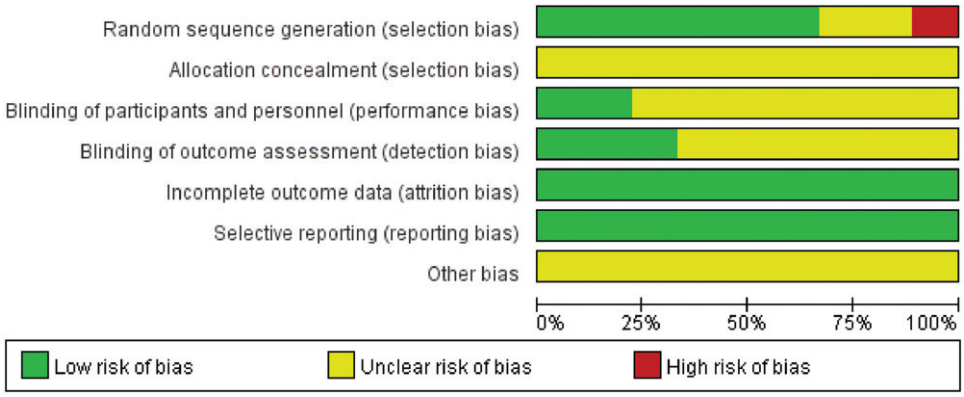

Figure 2. Risk of bias graph.

Effects of walking on constipation. Five studies [24,26,29,31,32] assessed the effects of walking on constipation. Durations of intervention ranged from 4 weeks to 12 weeks. Four of these studies [26,29,31,32] provided RR values, while one article [24] provided symptom scores and was not included in this meta-analysis. After walking intervention, symptoms of constipation were significantly improved (RR = 1.98; 95% CI: 1.05, 3.73; $p = .035$) compared to different control groups such as: 1) usual care [29], 2) normal lifestyle [31], 3) Maziren pills [26] and 4) auricular acupuncture [32], but there was great heterogeneity among studies (I^2=87.8%, $p = .000$) (shown in Figure 5). Wu et al. [32] found that the efficacy of the 20–30 min daily walking was better than auricular acupuncture, after 30 days of intervention and 12 months of follow-up. Yi et al. [26] found that the improvement of feces characteristics and bloating in the intervention group was significantly better than in the control group ($p < .01$). Tantawy et al. [24] found that intergroup comparisons showed that patients in the intervention group presented greater improvements in quality of life, both in terms of physical and emotional aspects ($p < .05$). De Schryver et al [31], after a 12 weeks intervention period, found that accelerated transit times were evident in the intervention group (17.59 ± 2.5 vs. 9.69 ± 1.6 h; $p < .005$). Total colonic transit time did not change in control group, whereas in intervention group a significant reduction was observed after this activity program.

Effects of physical movement on constipation. Only one study assessed physical movement intervention. Jing et al. [27] found that after an eight-week intervention period, compared with the control group, constipation symptoms, general well-being, positive affection and negative affection, positive experience and negative experience were all significantly improved for elderly persons in nursing homes ($p < .01$).

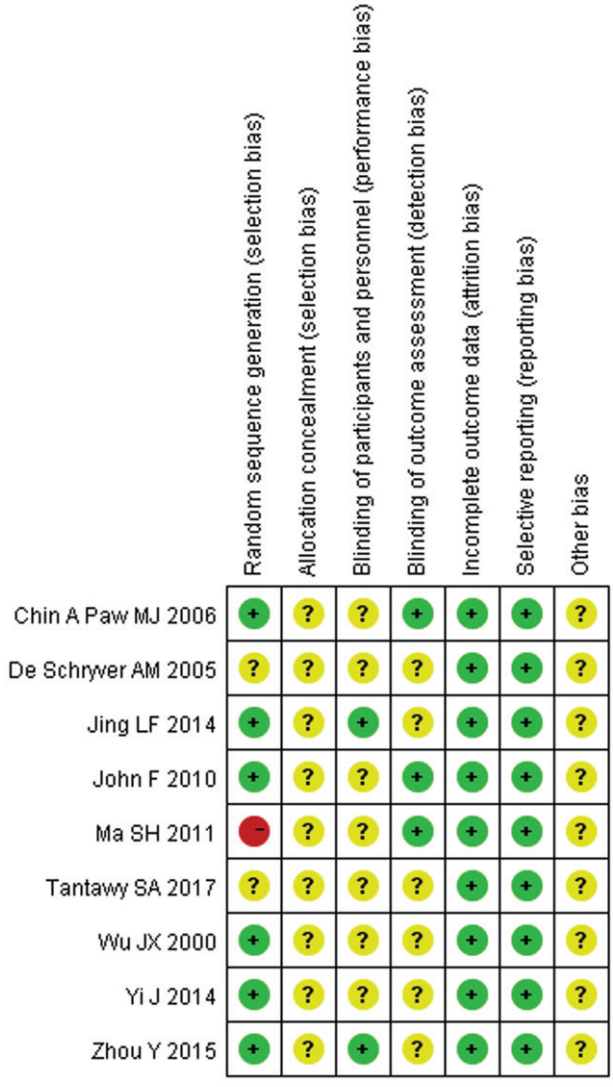

Figure 3. Risk of bias summary.

Discussion

This systematic review and meta-analysis of nine randomized controlled trials found that constipation symptoms, quality of life, and well-being were improved significantly in patients with constipation following exercise interventions. Among assessed interventions, aerobic exercise had a significant positive impact on constipation. Only one article assessed anaerobic exercise, finding that resistance training did not affect the habitual exercise habits or constipation symptoms of patients.

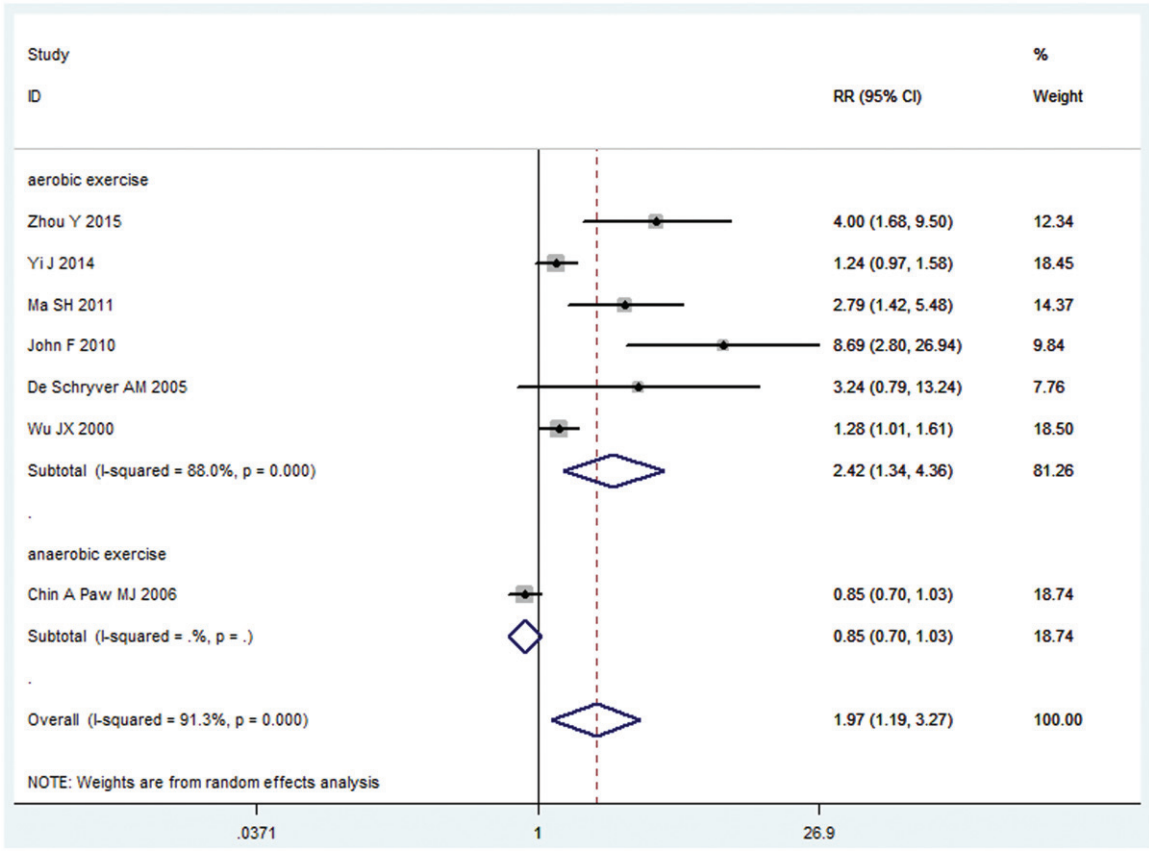

Figure 4. Forest plot of the effects of aerobic exercise and anaerobic exercise (Random-effects model).

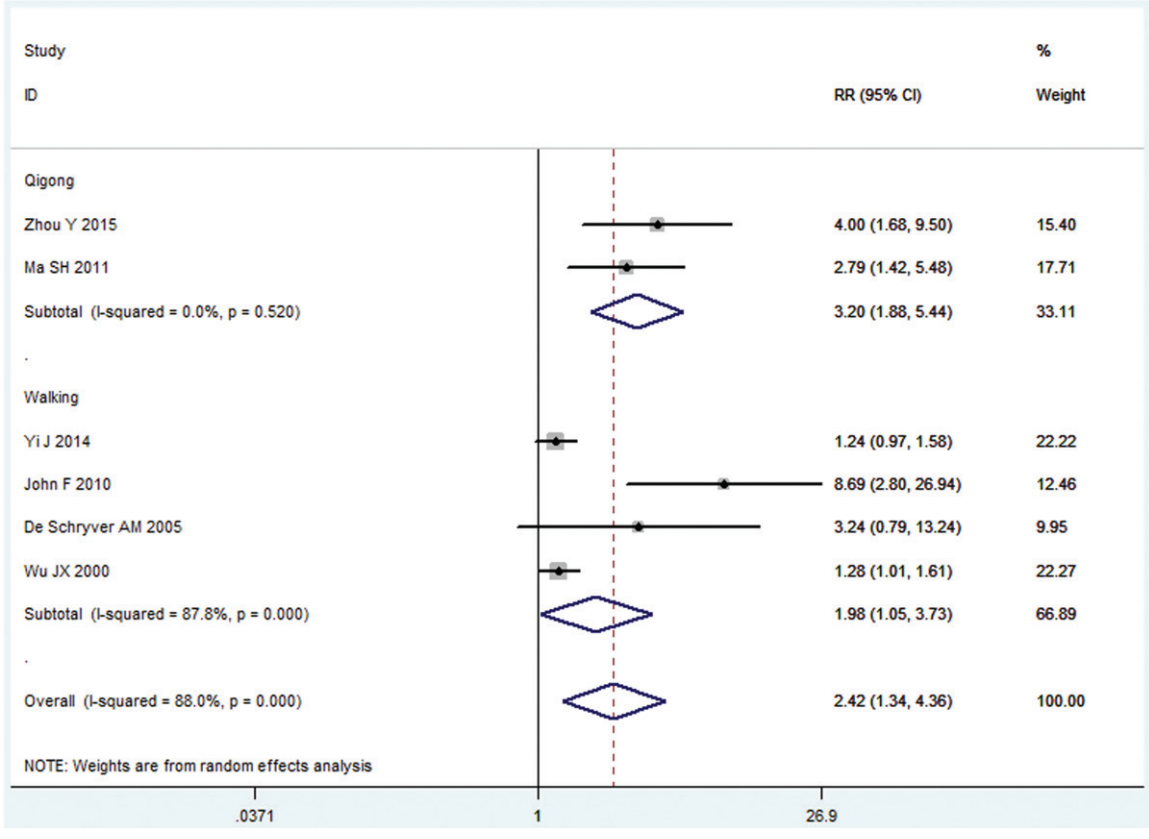

Figure 5. Forest plot of subgroup analyses for aerobic exercise studies.

Our findings indicate that aerobic exercise can improve constipation symptoms, consistent with other studies which have found that mild physical activity can improve abdominal distension [33,34] and alleviate bloating [34]. This may be due to the effect of exercise on colonic motility, accelerates gastrointestinal transit and increases the stimulation of the abdominal muscles to thereby help stool move into the rectum [35–39].

Our results also indicated that the quality of life and well-being of patients with constipation were significantly improved through exercise. Consistent with this, in a study of patients with constipation-predominant irritable bowel syndrome (IBS-C), symptoms and quality of life were found to be improved after a 24-week aerobic exercise intervention [40]. We, therefore, speculate that these observed improvements in well-being and quality of life may be a result of observed improvements in constipation symptoms. Indeed, other studies of exercise interventions have found these interventions to be associated with better health outcomes, including better general and health-related quality of life, better functional capacity, and better mental health outcomes [41,42].

In this systematic review and meta-analysis, we found that in studies of aerobic exercise intervention in which constipation symptoms were effectively improved, aerobic exercise time was generally conducted for 140 min or more weekly [24,25,27,28,32]. Only one study which observed improvements in constipation symptoms involved a shorter exercise period, with subjects walking for 100 min weekly [29]. Other aerobic exercises lasting less than 140 min per week seemed to have no effect on the improvement of constipation symptoms [31]. In the one study of anaerobic exercise included in this analysis, although the exercise intensity was greater than for aerobic exercise, the exercise duration was less than 140 min per week, and this intervention had no effect on constipation [30]. This result was relatively consistent with the recommendation made by the Physical Activity Guidelines Advisory Committee, which recommended a minimum of 150 min of moderate-intensity aerobic activity weekly [43]. Whether the application of aerobic exercise for a longer duration or with greater intensity will be associated with improved outcomes in constipation patients remains to be fully determined. However, we speculate that regardless of exercise intensity, longer exercise intervention times should be considered in order to better achieve improvements to constipation symptoms.

This systematic review and meta-analysis offer key insights regarding the effects of exercise on constipation. However, there are certain limitations to this analysis and the included studies that should be considered. For one, in general, the included studies had relatively high bias risk and relatively low methodological quality. For example, in some studies the description of random sequence generation and distribution was inadequate [24,28,31], no studies performed allocation concealment [24–32], and few studies conducted blinding of participants and personal and blinding of outcome assessments [25,27–30]. These factors may limit the reliability of the results of these studies. In addition, in some of the articles we included, there was no exercise supervision, and we, therefore, could not determine with certainty as to whether the participants had completed the exercise plan [24,26,32]. In addition, the compliance of the participants was poor in some studies, wherein they could not complete the exercise plan according to protocol, potentially leading them to overestimate their own physical activity [30]. All of these issues could influence constipation outcomes. Third, only one study in this meta-analysis conducted follow-ups for a one year period after the intervention [32], with no other studies conducting any regular long-term follow-up, preventing us from assessing the long-term effects of exercise interventions on constipation. Fourth, only one study evaluated the impact of resistance training on constipation [30], and given this insufficient sample size, more research is needed to confirm the role of such training in improving constipation symptoms. The included studies also included a range of exercise interventions and lacked universal assessment tools, potentially substantially increasing study heterogeneity. Furthermore, more study is needed to compare the efficacy of exercise to other potential interventions as a means of treating constipation. Studies included here in failed to provide safety evaluations, and more work will be needed to identify optimal exercise intensity and duration. In addition, of the nine articles included here, five are from China [25–28,32], two from the Netherlands [30,31], one from Egypt [24] and one from the United States [29]. More research will be needed to explore whether there are regional or cultural limitations on the feasibility and suitability of this intervention for constipation treatment. Given these many limitations on the present meta-analysis, caution is warranted when interpreting our finding that exercise is associated with improved constipation symptoms.

Conclusion

Our results suggest that exercise, especially aerobic exercise, may be a viable and effective treatment for patients with constipation. However, based on our findings, no clear recommendations can be made and as such in the future researchers should design more rigorous studies aimed at assessing the impact of exercise on constipation.

Disclaimers

The views expressed in the submitted article are our own and not an official position of the institution or funder.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the National Natural Science Foundation of China under Grant 81570491.

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MEDICAL SCIENCE MONITOR

CLINICAL RESEARCH

e-ISSN 1643-3750
© Med Sci Monit, 2017; 23: 2660-2667
DOI: 10.12659/MSM.904040

Received: 2017.02.25
Accepted: 2017.05.18
Published: 2017.05.31

Prevalence and Risk Factors of Chronic Constipation Among Women Aged 50 Years and Older in Shanghai, China

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Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Source of support: This study was supported by the Natural Science Foundation of Shanghai (No. 201440351and ZK2015A32)

Background: Chronic constipation (CC) is a major public health problem worldwide, especially in elderly women. This study aimed to investigate the prevalence and risk factors of CC among women aged 50 years and older in Shanghai, China.

Material/Method: A cross-sectional survey was conducted on 1950 women aged 50 years and older, randomly sampled in Yangpu District of Shanghai from April to October 2015. Information on demographic characteristics, lifestyle habits, medical history, and defecation situation was collected through in-person interviews. CC was defined according to Rome III criteria. The data were analyzed by chi-square test and multiple logistic regression analysis.

Results: The response rate to the survey was 80.4%. Of the 1568 participants, 77 were diagnosed with CC, with a prevalence of 4.9%. Moreover, the prevalence increased with advancing age. Multiple logistic analyses showed that body mass index (BMI) ≥25.0 kg/m^2, non-manual occupation, premenopausal period, no delivery history, poor sleep quality, meat-based diet, and less physical exercise were significant risk factors for CC in the population of women aged 50 years and older.

Conclusions: CC was a common health problem among women aged 50 years and older in Shanghai, and the prevalence was positively associated with BMI ≥25.0 kg/m^2, non-manual occupation, premenopausal period, no delivery history, poor sleep quality, meat-based diet, and less physical exercise. Further studies are needed to identify the risk factors and potential interventions for CC.

MeSH Keywords: Constipation • Prevalence • Risk Factors • Women

Full-text PDF: http://www.medscimonit.com/abstract/index/idArt/904040

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Background

Constipation is characterized by unsatisfactory defecation that results from infrequent stools, difficult stool passage, or both [1]. Various studies have indicated that chronic constipation (CC) has a major negative impact on quality of life, affecting both physical and emotional well-being [2,3]. In recent years, CC has become a common health problem worldwide, resulting in a major economic and social burden [4,5]. According to reports from Western countries, the prevalence of CC in the general population ranges from 2% to 28%, with an increasing trend over years [1,6,7]. Moreover, severe constipation is frequently observed in elderly women, with rates of 2 to 3 times higher than that of their male counterparts [6,8]. CC is a heterogeneous disorder, with multiple causes, including dysfunction of intestinal motility, visceral sensitivity, anorectal musculature, and the enteric nervous system [9]. In addition, many factors may also contribute to the development of CC, such as age, gender, physical activity, dietary habits, medication use and psychological parameters [6,10].

However, CC has so far received much less investigative attention in Asian populations as compared with Western populations. What's worse, many people in Asian countries, especially the elderly and women, have a relatively poor knowledge of how to prevent CC [11]. Therefore, it is extremely important to know the magnitude of the problem in this population, as well as the associated factors involved, so that preventive measures can be applied. The purpose of the present study was to estimate the prevalence of CC and its associated risk factors among women aged 50 years and older in Shanghai, China.

Material and Methods

Study design and population

This study was a population-based, cross-sectional field survey among women aged 50 years and older and living in the communities of Yangpu District, Shanghai, China. To select a representative sample of the population, a stratified multistage clustered probability sampling design was applied [12]. A total of 1950 eligible women from 8 communities were contacted to participate in this survey from April to October 2015. The survey was conducted at participations' homes by well-trained interviewers using a structured questionnaire, which included demographic characteristics, lifestyle habits, medical information, and defecation situation. Fasting blood glucose (FBG) and anthropometric measurements, including current weight, height, and circumferences of the waist and hips, were also taken by using a standard protocol. This study was conducted according to the principles of the Declaration of Helsinki [13] and was approved by the Research Ethics Committee of Yangpu Hospital. Written informed consent was obtained from all participants.

Contents of survey

The survey consisted of 4 parts: (1) General information, which included age, body mass index (BMI), waist-to-hip ratio (WHR), FBG, marital status, educational level, current/past occupation, menstrual situation, and delivery history. BMI was defined as weight in kilograms divided by height in meters squared, and participants were categorized as normal weight (<25.0 kg/m^2) or overweight/obese (≥25.0 kg/m^2) [14]. WHR was defined as waist circumference divided by hip circumference, and women with a WHR >0.85 were classified as having central obesity [15]; (2) Lifestyle habits, which included smoking and alcohol-drinking history, self-rated sleep quality, diet structure, frequencies of fruit consumption, and physical exercise. A positive smoking history was defined as smoking more than 5 cigarettes per week for at least 1 year, and a positive drinking history was defined as drinking more than 35 g of alcohol at least twice a week. Self-rated sleep quality was determined as a response to the question "Would you say that, in general, your sleep quality is good, fair, or poor?" Responses were dichotomized into good/fair and poor. Meat-based diet was defined as a consumption of raw vegetables <100 g/day, a ratio of refined grain products to whole grain products >0.95 and a consumption >105 g/week of meat products or >300 g/week of meat. Adequate fruit consumption was defined as 2 or more servings of fruit (300 g/serving) per day, and participants were grouped into either ≥4 days/week or ≤3 days/week. Regular physical exercise was defined as participation in any physical activity that was performed long enough to sweat at least 3 times a week; (3) Medical information was collected by asking "Has a doctor or other health professional ever told you that you have [disease]?" and "Have you ever had abdominal and/or gynecological surgery?" Disease types were deemed positive according to self-report: hypertension, cardiovascular disease, cerebrovascular disease, hyperlipidemia, steatohepatitis, diabetes, cholelithiasis, and thyroid disease; and (4) CC was defined according to Rome III criteria with the following constipation judgment indicators: defecation less than 3 times per week, stool weight of less than 35 g/d, dry and hard stool, difficulty in defecating during more than 25% of evacuation attempts, and symptom onset over 6 months [16].

Statistical analysis

Statistical analyses were performed by SPSS software (SPSS 19.0, IBM, Chicago, IL). The prevalence and 95% confidence intervals (CIs) of CC were calculated for the entire population and the population by age group. Chi-square and *t* tests were used to analyze the differences in patient characteristics and outcomes. Multivariable logistic regression analyses were utilized to

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Table 1. Prevalence of chronic constipation by age group.

	Study population	CC	Prevalence, % (95% CI)
Total	1568	77	4.9 (3.8–6.0)
Age (years)			
50–59	572	26	4.5 (2.8–6.3)
60–69	653	32	4.9 (3.2–6.6)
70–79	226	12	5.3 (2.4–8.2)
≥80	117	7	6.0 (1.7–10.3)

CC – chronic constipation; CI – confidence interval.

identify risk factors for CC while controlling potential confounders [17]. The odds ratio (OR) and 95%CI were estimated for each factor. A *P* value of <0.05 was considered statistically significant.

Results

Prevalence and characteristics of CC

Of 1950 eligible women, 382 refused to participate, and finally 1568 (80.4% response rate) were recruited and completed the survey. Among them, 77 women were diagnosed with CC based on Rome III criteria, with a prevalence of 4.9% (95% CI 3.8–6.0%). Moreover, the prevalence of CC increased with advancing age, from 4.5% in the 50–59 years age group to 6.0% in the ≥80 years age group (Table 1). However, no significant difference in age distribution was observed between individuals with and without CC (*P*=0.573). Compared with the non-CC group, women with CC were more likely to be overweight/obese (*P*=0.046), engage in non-manual work (*P*=0.009), and eat meat-based diets (*P*=0.013), but less likely to perform physical exercise (*P*=0.011). In addition, they were more likely to be in premenopausal period (*P*<0.001), have no delivery history (*P*=0.001), and suffer poor sleep quality (*P*<0.001) (Table 2).

Risk factors associated with CC

Multivariate logistic regression analyses were conducted to evaluate the association of CC with each variable after adjustment for potential confounders (Table 3). The results showed that BMI ≥25.0 kg/m^2 (OR=2.34, 95% CI 1.34–4.08), non-manual occupation (OR=2.41, 95% CI 1.33–4.35), premenopausal period (OR=4.86, 95% CI 2.31–10.24), no delivery history (OR=6.91, 95% CI 2.47–19.31), poor sleep quality (OR=2.99, 95% CI 1.79–4.99), meat-based diet (OR=2.29, 95% CI 1.01–5.19), and less physical exercise (OR=1.65, 95% CI 1.02–2.70) were significant risk factors for CC in the population of women aged 50 years and older, whereas no significant association was detected for age, educational level, or diabetes.

Discussion

In this study, we found that the prevalence of CC among women aged 50 years and older in Shanghai was 4.9%, and the prevalence was positively associated with BMI ≥25.0 kg/m^2, non-manual occupation, premenopausal period, no delivery history, poor sleep quality, meat-based diet, and less physical exercise. To our knowledge, this is the first study specifically designed to estimate the epidemiology of CC among women aged 50 years and older in China.

CC is a major public health problem worldwide, especially in elderly women. However, the reported prevalence of CC varies widely between studies, which may be mainly attributed to geographical factors, differences in the definitions used, and the age distributions of study populations [18,19]. Our study cohort consisted of women aged 50 years and older in Shanghai, China, a population in which the prevalence of CC has not been studied in depth previously. According to Rome III criteria, the prevalence of CC was found to be 4.9% in this study population. This finding is substantially lower compared to the prevalence reported for many elderly female populations in Western countries (12–34%) [1,20–22]. The Rome IV criteria were published in 2016 and are similar to Rome III but further emphasize the subtypes of constipation [23]. We also compared the Rome III and Rome IV criteria for the diagnosis of CC, and found the same prevalence in our study population. In addition, consistent with the previous studies [24,25], we found that the prevalence of CC increased with advancing age.

In this study, we also evaluated the potential risk factors for CC. Age effects on the prevalence of constipation have been frequently reported in previous studies [18]. Our study data showed that the prevalence of CC increased with age, but no significant association was identified in the multiple logistic analyses, suggesting that age might not be a major risk factor for constipation in this study population. Poor lifestyle habits and psychological well-being have also been suggested as

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Table 2. Sociodemographics and medical information of individuals with and without chronic constipation.

Variables	CC (n=77)		Non-CC (n=1491)		P value
Age (years)					
Median (Range)	62	(50-85)	62	(50-91)	0.573
BMI (kg/m^2)					
<25.0	43	(55.8%)	1005	(67.4%)	
≥25.0	34	(44.2%)	486	(32.6%)	**0.046**
WHR					
≤0.85	36	(46.8%)	602	(40.4%)	
>0.85	41	(53.2%)	889	(59.6%)	0.285
Marital status					
Married	64	(83.1%)	1309	(87.8%)	
Single/divorced/widowed/separated	13	(16.9%)	182	(12.2%)	0.286
Educational level					
<High school	39	(50.6%)	868	(58.2%)	
≥High school	38	(49.4%)	623	(41.8%)	0.195
Current/past occupation					
Manual	57	(74.0%)	1275	(85.5%)	
Non-manual	20	(26.0%)	216	(14.5%)	**0.009**
Menstrual situation					
Postmenopausal	64	(83.1%)	1428	(95.8%)	
Premenopausal	13	(16.9%)	63	(4.2%)	**<0.001**
Delivery history					
Yes	70	(90.0%)	1465	(98.3%)	
No	7	(9.1%)	26	(1.7%)	**0.001**
Smoking history					
Yes	4	(5.2%	42	(2.8%)	
No	73	(94.8%)	1449	(97.2%)	0.281
Alcohol-drinking history					
Yes	7	(9.1%)	71	(4.8%)	
No	70	(90.9%)	1420	(95.2%)	0.101
Self-rated sleep quality					
Good/fair	45	(58.4%)	1175	(78.8%)	
Poor	32	(41.6%)	316	(21.2%)	**<0.001**
Meat-based diet					
No	68	(88.3%)	1421	(95.3%)	
Yes	9	(11.7%)	70	(4.7%)	**0.013**
Frequency of fruit consumption					
≥4 days/week	50	(64.9%)	968	(64.9%)	
≤3 days/week	27	(35.1%)	523	(35.1%)	1.000
Frequency of physical exercise					
≥3 days/week	38	(49.4%)	957	(64.2%)	
≤2 days/week	39	(50.6%)	534	(35.8%)	**0.011**

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Table 2 continued. Sociodemographics and medical information of individuals with and without chronic constipation.

Variables	CC (n=77)		Non-CC (n=1491)		P value
Hypertension					
Yes	28	(36.4%)	649	(43.5%)	
No	49	(63.6%)	842	(56.5%)	0.239
Cardiovascular disease					
Yes	14	(18.2%)	375	(25.2%)	
No	63	(81.8%)	1116	(74.8%)	0.179
Cerebrovascular disease					
Yes	7	(9.1%)	139	(9.3%)	
No	70	(90.9%)	1352	(90.7%)	1.000
Hyperlipidemia					
Yes	11	(14.3%)	275	(18.4%)	
No	66	(85.7%)	1216	(81.6%)	0.372
Steatohepatitis					
Yes	18	(23.4%)	370	(24.8%)	
No	59	(76.6%)	1121	(75.2%)	0.790
Diabetes					
Yes	14	(18.2%)	205	(13.7%)	
No	63	(81.8%)	1286	(86.3%)	0.310
FPG (mmol/L)					
<7.0	66	(85.7%)	1351	(90.6%)	
≥7.0	11	(14.3%)	140	(9.4%)	0.156
Cholelithiasis					
Yes	10	(13.0%)	244	(16.4%)	
No	67	(87.0%)	1247	(83.6%)	0.527
Thyroid disease					
Yes	8	(10.4%)	187	(12.5%)	
No	69	(89.6%)	1304	(87.5%)	0.606
Abdominal and/or gynecological surgery					
Yes	23	(29.9%)	389	(26.1%)	
No	54	(70.1%)	1102	(73.9%)	0.507

CC – chronic constipation; BMI – body mass index; WHR – waist-to-hip ratio; FPG – fasting blood glucose.

important risk factors for CC [10,18]. These were evident in our study as being overweight/obese, less physical exercise, meat-based diet, and poor sleep quality were found to contribute significantly to CC. Moreover, we found that women in premenopausal period or with no delivery history appeared to be more likely to suffer from constipation, which might be associated with the fluctuations in female sex hormones and emotions [26,27]. We also observed that, compared with manual workers, non-manual workers tended to have a higher risk for CC. A possible explanation for this phenomenon was that they had a more sedentary lifestyle and greater mental stress [28,29]. However, in our study, no significant association with CC was detected for educational level or diabetes, which had been reported in some studies [30,31]. Given that the pathophysiology of constipation is not clearly identified as yet, the causes for these differences remain to be elucidated. In addition to these factors, medication use may also be implicated in the development of constipation. Many drug classes, including diuretics, antidepressants, aluminum-containing antacids, antihistamines, opioids, antispasmodics and anticonvulsants, have been reported to be associated with a nearly 2- to 3-fold increased risk of CC [32]. Unfortunately, because

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Table 3. Multivariate logistic analysis of risk factors associated with chronic constipation.

Variables	OR (95% CI)	P value
Age (years)		
<70	1 (reference)	
≥70	1.39 (0.72–2.66)	0.326
BMI (kg/m²)		
<25.0	1 (reference)	
≥25.0	2.34 (1.34–4.08)	**0.003**
WHR		
≤0.85	1 (reference)	
>0.85	0.61 (0.36–1.04)	0.067
Marital status		
Married	1 (reference)	
Single/divorced/widowed/separated	1.39 (0.70–2.76)	0.347
Educational level		
<High school	1 (reference)	
≥High school	1.12 (0.66–1.91)	0.675
Current/past occupation		
Manual	1 (reference)	
Non-manual	2.41 (1.33–4.35)	**0.004**
Menstrual situation		
Postmenopausal	1 (reference)	
Premenopausal	4.86 (2.31–10.24)	**<0.001**
Delivery history		
Yes	1 (reference)	
No	6.91 (2.47–19.31)	**<0.001**
Smoking history		
Yes	1 (reference)	
No	1.10 (0.34–3.60)	0.874
Alcohol-drinking history		
Yes	1 (reference)	
No	0.56 (0.23–1.38)	0.208
Self-rated sleep quality		
Good/fair	1 (reference)	
Poor	2.99 (1.79–4.99)	**<0.001**
Meat-based diet		
No	1 (reference)	
Yes	2.29 (1.01–5.19)	**0.048**
Frequency of fruit consumption		
≥4 days/week	1 (reference)	
≤3 days/week	0.92 (0.55–1.55)	0.752
Frequency of physical exercise		
≥3 days/week	1 (reference)	
≤2 days/week	1.65 (1.02–2.70)	**0.043**

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Table 3 continued. Multivariate logistic analysis of risk factors associated with chronic constipation.

Variables	OR (95% CI)	P value
Hypertension		
Yes	1 (reference)	
No	1.48 (0.84–2.61)	0.171
Cardiovascular disease		
Yes	1 (reference)	
No	1.61 (0.82–3.18)	0.169
Cerebrovascular disease		
Yes	1 (reference)	
No	1.01 (0.41–2.53)	0.979
Hyperlipidemia		
Yes	1 (reference)	
No	1.43 (0.70–2.92)	0.323
Steatohepatitis		
Yes	1 (reference)	
No	1.09 (0.58–2.07)	0.784
Diabetes		
Yes	1 (reference)	
No	0.66 (0.30–1.47)	0.313
FPG (mmol/L)		
<7.0	1 (reference)	
≥7.0	1.32 (0.56–3.10)	0.531
Cholelithiasis		
Yes	1 (reference)	
No	1.47 (0.70–3.11)	0.314
Thyroid disease		
Yes	1 (reference)	
No	1.45 (0.66–3.21)	0.357
Abdominal and/or gynecological surgery		
Yes	1 (reference)	
No	0.77 (0.45–1.35)	0.364

CC – chronic constipation; BMI – body mass index; WHR – waist-to-hip ratio; FPG – fasting blood glucose; OR – odds ratio; CI – confidence interval.

of the self-reported nature of the survey, we failed to acquire sufficient data about medication use and estimate the effect of previous treatment for constipation.

Some other limitations of this study should be acknowledged. First, there was limited generalizability of the findings as the sample was recruited from only 1 district of Shanghai. Second, most variables investigated were self-reported; hence, the potential for recall bias was inevitable. In addition, due to the cross-sectional design, a causal relationship between CC and risk factors could not be determined. Hence, further population-based studies with larger sample sizes and long-term follow-up are required to identify the risk factors and potential interventions for CC.

Conclusions

Our study results suggest that CC is a common gastrointestinal disorder among women aged 50 years and older in Shanghai, with a prevalence of 4.9%. Moreover, BMI ≥25.0 kg/m^2, non-manual occupation, premenopausal period, no delivery history, poor sleep quality, meat-based diet, and less physical exercise were the potential risk factors for CC in elderly women.

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Original Article

Irritable Bowel Syndrome: Epidemiology and Risk Factors in the Adult Saudi Population of the Central Region

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Abstract

Background: Irritable bowel syndrome (IBS) is the most common functional gastrointestinal disease. The prevalence of IBS is estimated to be 11.2% worldwide and even though it is not a life-threatening condition, it affects the quality of life and results in an economic burden on the healthcare system. According to the Rome III criteria, IBS is described as abdominal pain that improves with defecation and the onset of the pain is associated with a change in stool frequency or consistency that cannot be explained by any biochemical or structural abnormality. **Aim:** To document the epidemiology of IBS and its associated risk factors in the central region of Saudi Arabia. **Materials and Methods:** A cross-sectional study conducted in the central region of Saudi Arabia, carried out by distributing an online self-administered semi-structured questionnaire. The questionnaire was distributed online in social media and websites. The sample size was 426 participants with a precision of ± 5% and 95% confidence interval (CI). The questionnaire included demographic characters such as age, gender, occupation, and marital status. The questionnaire also included body mass index (BMI), smoking, family history of IBS, Rome III criteria for diagnosing IBS, and Hospital Anxiety and Depression Scale (HADS) for anxiety and depression. **Results:** A total of 426 (230 [54%] male and 196 [46%] female) participants were enrolled in the study. According to Rome III criteria, 130 had IBS and the prevalence was 30.5%. Univariate analysis showed that gender, anxiety, depression, and low physical activity are statistically significant variables with symptomatic IBS ($P < 0.05$). **Conclusion:** In this study, a high prevalence of IBS in the Central Saudi Arabia population was observed along with the presence of some modifiable risk factors, yet, the sample size was small which shows the need for more studies in this area particularly on the general population.

Keywords: *IBS, prevalence, risk factors, Saudi Arabia*

Received: 23-Jul-2020;
Revision: 24-Mar-2020;
Accepted: 09-Mar-2020;
Published: 12-Oct-2020

Introduction

Irritable bowel syndrome (IBS) is a gastrointestinal disorder characterized by abdominal pain and changes in bowel habits.[1] It is the most common functional gastrointestinal disease. The prevalence of IBS is estimated to be 11.2% worldwide even though it is not a life-threatening condition but it affects quality of the life, the prevalence of IBS in Asia is estimated to be 5%–10% which is less than western countries.[2,3] IBS results in an economic burden on the healthcare system. The direct annual cost of diagnosing and treating IBS in the United States is estimated between $1.7 and $10 billion. The indirect costs in terms of absenteeism, workdays lost, and disability will double the monetary figure estimated as direct costs.[4]

IBS is described as abdominal pain associated with changing bowel habits.[5] According to the Rome

Access this article online

Quick Response Code:

Website: www.njcponline.com

DOI: 10.4103/njcp.njcp_382_19

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How to cite this article: Aljammaz KI, Alrashed AA, Alzwaid AA. Irritable bowel syndrome: Epidemiology and risk factors in the adult Saudi population of the central region. Niger J Clin Pract 2020;23:1414-8.

III criteria, IBS is described as abdominal pain that improves with defecation and the onset of the pain is associated with a change in stool frequency or consistency that cannot be explained by any biochemical or structural abnormality.[6,7] Etiology is not well-understood and not clear, many risk factors are involved including adolescence, smoking, alcohol consumption, stress, anxiety, physical activity, and positive family history.[8] various criteria used for diagnosing IBS including Rome I, Rome II, Rome III, and Manning criteria, but the most widely used criteria is Rome III.[9] The sociodemographic factors play a role in IBS prevalence.[10] Women are more likely to develop IBS 2–4 times compared to men.[10,11] IBS is more prevalent among those younger than 50 years compared to those older than 50 years old.[12,13] IBS is more prevalent among adolescents and declines with age.[14]

Numerous studies showed a significant distinction in prevalence between countriesdepending on the diagnostic criteria.[15] A study done at King Abdul-Aziz University in Jeddah, among medical students and interns, revealed that the prevalence of IBS is 31.8%.[16] A study done among secondary school male students in Al-Jouf Province, Saudi Arabia, showed that the prevalence was 8.9 and 9.2% according to Manning and Rome II Criteria, respectively.[17] However, both studies were conducted on students, it did not provide information about the other society members.

Although IBS is one of the commonest disorders, many studies focused on adolescents and students, but little is known about the prevalence of IBS among other community members in the Middle East, including Saudi Arabia. This study aims to document the epidemiology of irritable bowel syndrome and its associated risk factors in the central region of Saudi Arabia.

Materials and Methods

Research design and setting

A cross-sectional study conducted in the central region of Saudi Arabia during the period from March 2019 to May 2019. The study was carried out by distributing an online self-administered semi-structured questionnaire.

All the Saudis who live currently in the central region of the kingdom, who have fully completed all parts of the questionnaire and have given written informed consent will be included in the study. In contrast, those who have not fully completed the questionnaire or were found unwilling to participate will be excluded.

The sample size was calculated depending on an established formula n = (z^2 × p × q)/d^2. Where n = the minimum sample size. z = 1.96 P = 0.5 and q = (1 − p) = 0.5. After the calculations, the minimum sample size to achieve a precision of ± 5% with a 95% confidence interval (CI) is 384. After accounting for non-response and missing data the final number was decided to be 426.

Development and application of the questionnaire

The questionnaire included demographic characters such as age, gender, occupation, and marital status. The questionnaire also included body mass index (BMI), smoking, family history of IBS, sleep deprivation, fast food, spicy food, consumption of coffee and tea, and physical exercise that we hypothesized will have an association with inflammatory bowel syndrome.

We used the Rome III criteria for the diagnosis of IBS, it was done to assist the healthcare providers in determining the diagnoses of IBS. Was defined as the onset of symptoms at least 6 months before diagnosis based on recurrent abdominal pain or discomfort for at least 3 days per month during the past 3 months and associated with two or more of the following criteria:

a. Improvement of the symptoms with defecation
b. Onset associated with a change in stool frequency
c. Onset associated with a change in stool appearance.

We used the Hospital Anxiety and Depression Scale (HADS). This is a standardized, validated, reliable, and self-reporting scale. It includes two subscales for Anxiety (HADS-A) and Depression (HADS-D). There are seven questions for depression and seven for anxiety.

All points from the questionnaire were used from previously conducted questionnaires that were validated and professionally translated.

Procedure

Participants were selected randomly through volunteer sampling, and any volunteer will be welcome to participate.

Google form was utilized to distribute the questionnaire online in random social media forums and websites. Participants were asked to give their written informed consent before filling the survey.

Statistical analysis

After the collection of data, the variables were revised and entered, and statistical analyses were conducted using Statistical Package for Social

Sciences (SPSS) version 16.0 (SPSS, Inc, Chicago, IL). Continuous variables were represented as mean ± standard deviation (SD). The frequency was used for categorical variables. Chi-square was used to compare categorical variables. Univariate analysis was utilized to check the relation between IBS and each independent variable.

A *P* value of < 0.05 was considered statistically significant

Results

A total of 426 subjects participated in the study. According to the Rome III criteria, the prevalence of IBS was 130 (30.5%). According to HADS, the prevalence of depression was 59 (13.8%) and anxiety was 120 (28.2%). The age range of the participants was 14–65 years, male participants were 230 (54%) and female participants were 196 (46%). As for the occupation, 156 (36.6%) were working in the public sector and, 123 (28.9%) were college students. As for the BMI, 191 (44.8%) were (>25 kg/m^2). Current smokers were 84 (19.7%).

Participants with a family history of IBS were 206 (48.4%). Half of the participants 77 (65.0%) drink coffee regularly, 233 (54.7%) drink tea regularly, and regular drinking was defined as drinking more than once a day. More than half the participants 247 (58.0%) sleep less than 7 h a day. Half of the participants 216 (50.7%) eat fast food regularly; 201 (47.2%) eat spicy food regularly, this is defined as 3 or more meals a week. Among the participants, 56 (13.1%) were performing a physical activity for 30 min more than 3 times per week while 175 (41.1%) were not performing any physical activity. Table 1 demonstrates the demographic characteristics and risk factors.

Regarding the associated risk factors with IBS symptoms, Table 2 represents a univariate analysis, shows that gender, depression, anxiety, and physically inactive participants showed statistical significance and association (*P* < 0.05) with symptomatic IBS. Although, smoking, positive family history of IBS, inadequate sleep, frequent consumption of fast food, spicy food, coffee, and tea. BMI (>25 kg/m^2) and age did not show statistical significance with IBS.

Table 1: Baseline characteristics of 426 participants

Parameters	*n* (%)
Age (years) (mean [SD]) [range]	29.8 (8.1) [14-65]
Male	230 (54.0%)
Female	196 (46.0%)
Job	
High school student	8 (1.9%)
College student	123 (28.9%)
Public sector	156 (36.6%)
Private sector	68 (16.0%)
Other	71 (16.7%)
BMI (>25 kg/m^2)	191 (44.8%)
Smoking status	
Non-smokers	342 (80.3%)
Current smokers	84 (19.7%)
Positive family history	206 (48.4%)
Inadequate sleep (<7 h)	274 (58.0%)
Frequent consumption of	
Fast food	216 (50.7%)
Spicy food	201 (47.2%)
Coffee	277 (65.0%)
Tea	233 (54.7%)
Physical activity (per week)	
Non	175 (41.1%)
Once	107 (25.1%)
2–3 times	88 (20.7%)
>3 times	56 (13.1%)
Inflammatory bowel syndrome	130 (30.5%)
Depression	59 (13.8%)
Anxiety	120 (28.2)

Table 2: Variables associated with IBS on univariate analysis

Characteristic	IBS (*n*=130)	NO IBS (*n*=296)	*P*
Age (years)			0.05
>25	81 (27.6%)	212 (72.4%)	
≤25	49 (36.8)	84 (63.2%)	
Gender - M:F (%)	58 (24.9%): 72 (37.3%)	175 (75.1%): 121 (62.7%)	0.006*
BMI >25 kg/m^2	60 (31.4%)	131 (68.6%)	0.71
Current smokers	24 (28.6%)	60 (71.4%)	0.66
Positive family history of IBS	61 (29.6%)	145 (70.4%)	0.69
Inadequate sleep	75 (30.4%)	172 (69.6%)	0.93
Anxiety	45 (37.5%)	75 (62.5%)	0.04*
Depression	26 (44.1%)	33 (55.9%)	0.01*
Frequent consumption of			
Fast food	73 (33.8%)	143 (66.2%)	0.13
Spicy food	66 (32.8%)	135 (67.2%)	0.32
Coffee	83 (30.0%)	194 (70.0%)	0.73
Tea	57 (24.5%)	176 (75.5%)	0.06
Physically inactive (per week)	97 (34.4%)	185 (65.6%)	0.01*

*Statistically significant (*P* < 0.05)

Discussion

This cross-sectional study was conducted to assess the prevalence of IBS using Rome III criteria and its associated risk factors in central Saudi Arabia. This study revealed that the prevalence was 30.5%. This result is considered high when compared to other studies in Asia (2–19%).[18] A study conducted in Jeddah among medical students revealed that the prevalence was 31.8% which is a similar prevalence to this study.[16] Another study conducted in European countries revealed that the prevalence was 11.5%.[19] Another study in Lebanon conducted on the general public revealed a prevalence of 20.1%.[20] This prevalence variation could be due to the use of varying diagnostic criteria or perhaps due to the difference between countries in terms of culture and dietary habits. Besides, the sample size could be the reason for such variation.

Regarding gender, in our study, female participants have a higher prevalence than males. A study in Lebanon conducted on university students revealed that females have a higher prevalence w[21]hereas another study in Lebanon conducted on the Lebanese community revealed that gender is not a statistically significant variable with IBS.[20] In China, a population-based study showed a lack of female predominance.[22] Furthermore, a systemic review study revealed that most of the reviewed studies showed that females have higher IBS prevalence than males. Several studies attributed higher prevalence rates among females to increase levels of serotonin in the brain[23] and pregnancy.[24]

In this study, HADS was used for the diagnoses of anxiety and depression and it was statistically significant to IBS. As for anxiety, Sugaya *et al*. 2008[25] revealed that symptoms of anxiety were found in 55.8% of participants with IBS. Many studies revealed that anxiety is related to IBS in various countries.[26-28] Regarding depression, a study in Japan conducted among the Community-dwelling population revealed that depression is statistically significant to IBS.[29] However, a study conducted in Jeddah among medical students revealed that there was no statistically significant difference between depression and IBS.[16] Understanding the association between IBS, anxiety, and depression can assist in the management of IBS patients.

Participants with a positive family history of IBS in this study were not found to have a statistically significant relation to IBS. However, family-based case-control research conducted in the United States revealed that a positive family history of IBS is statistically significant.[30] This suggests that further works studying the association between IBS and positive family history of IBS are needed.

As for physical activities associated with IBS, in this study, we found that low physical activity is statistically significant with IBS. In the literature review, most of the studies had similar outcomes. For instance, a randomized control trial revealed that an increase in physical activity improves IBS symptoms.[31] Whereas a study conducted in Iran showed that those with sedentary physical activity had a 1.27 times greater probability of suffering from IBS.[32] Given that, physical activity should be recommended alongside medical and psychological support.

Looking at IBS studies done in Saudi Arabia, we can observe that most of them were done on medical students.[16,33,34] Although, other studies worldwide were commonly conducted on the general population.[20,22,29] Thus, more studies on the community population in Saudi Arabia with a larger sample size are needed to confirm the results of this study.

In summary, IBS is the most common functional gastrointestinal disease. Hence, more studies with larger sample sizes among the community population to assess the prevalence as well as the associated risk factors of IBS to support preventive measures are needed.

Conclusion

Finally, after analyzing the results of this study we can see a high prevalence of IBS in Central Saudi Arabia's general population and the presence of modifiable risk factors, yet, the sample size was not large enough to gain conclusive evidence, which necessitates the need for more studies in this area particularly on the general public.

Acknowledgments

The authors would like to extend their gratitude to Saad A Alotaibi for helping with data collection.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of Interest

There are no conflicts of interest.

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ORIGINAL ARTICLE

AG-2019-119
doi.org/10.1590/S0004-2803.202000000-22

Nutritional status, quality of life and life habits of women with irritable bowel syndrome: a case-control study

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Received: 22 August 2019
Accepted: 17 January 2020

ABSTRACT – **Background** – Irritable bowel syndrome is a functional and chronic gastrointestinal disorder that may cause abdominal pain and altered bowel habits, affecting the nutritional status and quality of life of its carriers. Its prevalence is high, affecting about 10% to 15% of the general population in developed countries, being more prevalent in women than in men in the proportion 2:1. **Objective** – The aim of our study was to compare the profile of body adiposity, life habits, and the quality of life of women with irritable bowel syndrome with a healthy control group. **Methods** – Case-control study on 70 women, 34 with irritable bowel syndrome and 36 healthy. We applied the "Irritable Bowel Syndrome Quality of Life Questionnaire" to assess quality of life. Body adiposity was assessed from body mass index, waist circumference, and waist-to-hip ratio. We investigated the self-reporting of gastrointestinal symptoms with food deemed as problematic for carriers of irritable bowel syndrome and the presence of typical comorbidities. Assessment of life habits included: practice of physical activities, alcoholism, smoking, daytime sleepiness, and exclusion of foods from the feeding routine. For statistical analysis we used the IBM SPSS program, with a significance level at 5%. **Results** – There was higher volume of central and general adiposity in the case group compared with the control group ($P<0.05$). Cases presented a higher chance of developing IBS-related comorbidities ($P<0.05$). About of 80% of patients with irritable bowel syndrome have excluded some food from the diet ($P<0.01$) and the total amount of troublesome foods varied from 7 to 21 ($P<0.01$). The case group featured worse quality of life compared with the control ($P<0.05$). **Conclusion** – Compared to the control group, women with irritable bowel syndrome showed greater body adiposity, higher frequency of comorbidities, greater restriction on the consumption of problematic foods and worse quality of life.

HEADINGS – Irritable bowel syndrome. Adiposity. Life style. Quality of life.

INTRODUCTION

Irritable bowel syndrome (IBS) is a functional, chronic, and often disabling gastrointestinal disorder, characterized by change in bowel habits including diarrhea, constipation, pain and/or discomfort, flatulence and distension[1,2]. Its prevalence is high, affecting about 10% to 15% of the general population in developed countries, being more prevalent in women than in men in the proportion 2:1[2,3].

In Western countries, IBS is associated with worse quality of life (QOL), economic impact on work absenteeism, and productivity lost, resulting in an average annual spending of billions of dollars on medical assistance[1,2]. Patients with IBS feature significant impact on health-related QOL, particularly concerning energy/fatigue, functional limitations due to physical health problems, bodily pain, and overall perception of health[4]. Both gastrointestinal symptoms and psychiatric comorbidities (anxiety and depression) independently contribute to the decreased QOL of these patients[5]. The patients' fear of gastrointestinal symptoms having adverse consequences is also a predictive of impaired QOL and increased distress[6].

Obesity is a possible comorbidity of IBS, since intestinal motility, subclinical inflammation, diet, and gut microbiota may be interrelated[7,8]. Over the last decade, some studies aimed to find associations between body adiposity, gastrointestinal symptoms, and IBS[9-17]. Nagasako et al.[9] identified high frequencies of excess weight in patients with IBS. For bariatric patients with IBS, an improvement of IBS symptoms was demonstrated with weight reduction after the bariatric surgery intervention[13]. Authors of a recent study on morbid-obesity patients submitted to moderate caloric restriction identified improve in gastrointestinal symptoms of IBS after weight loss[14]. However, other studies did not find higher risk of IBS in obese subjects and this association is still inconclusive[15-18].

In addition, the consumption of some foods can exacerbate gastrointestinal symptoms of IBS. Main foods regarded as troublesome are sources of carbohydrates that are highly fermentable and of low absorption in the intestine, which include fructose in excess of glucose, lactose, oligosaccharides, and polyols, the so-called FODMAPs acronym[19,20]. Other troublesome foods for IBS carriers may be spicy foods, greasy foods, sources of biogenic

Declared conflict of interest of all authors: none
Disclosure of funding: Financial support from the National Council for Scientific and Technological Development (CNPq) and São Paulo Research Foundation – FAPESP process no. 15/24918-2 and 15/24920-7.
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amines, lectins, and preservatives as well as foods that can trigger the endogenous secretion of histamine[21]. However, the self-reported frequencies for each of these groups in IBS is not well understood.

Few authors have investigated the role of life habits in the development and symptoms of IBS. In a case-control study, the pattern of alcoholic beverages consumption did not differ between patients with IBS and those from the healthy control group, and mild and moderate drinking were poorly associated with gastrointestinal symptoms[22]. On the other hand, the excessive consumption of alcoholic beverages been strongly associated with gastrointestinal symptoms in patients with IBS when compared with controls[22]. Regarding the use of tobacco, in a recent systematic review carried out by Sirri et al.[23], the authors could not state a significant statistical association with IBS. Different impairments among studies and the lack of prospective studies hindered the generalization and comparability between them[23]. Regarding sleep and physical exercise, was demonstrated that sedentary individuals are 3.5 times more likely to suffer from IBS symptoms than those who were physically active[24]; in parallel, those with good quality of sleep were 0.13 times less likely to be affected with IBS symptoms than those with sleep impairment[24].

Due to the great challenge that IBS became to health professionals and the remaining gaps in relation to its clinical-behavioral handling, our objective was to investigate associations between quality of life, body adiposity, self-reporting of gastrointestinal symptoms concerning troublesome foods, and life habits of patients with IBS, compared with a group of healthy individuals.

METHODS

Ethical considerations

Our study was approved by the Research Ethics Committee of the University of Campinas (protocol no. CAAE – 64341316.0.0000.5404). An Informed Consent Form was individually presented and read to all research volunteers. All evaluations were carried out only upon the volunteers' acceptance and signature.

We have acquired the informed consent after indicate all possible physical and psychological damages on subjects and/or their guardians before the experiment is conducted, in accordance with the Declaration of Helsinki.

Study design and casuistry

Case-control study design, with two convenience samples, being one sample composed of 34 women with IBS, namely the case group, and other sample with 36 healthy women, namely the control group. It was evaluated women aging between 20 and 59 years. Such sample was chosen because of the greater prevalence of IBS in women compared with men[25].

The case group was composed of patients with IBS who have been selected from the Specialized Outpatient Clinic (*Ambulatório Médico de Especialidades* – AME) of Limeira, in the state of São Paulo, Brazil; and from the Gastroenterology Outpatient Clinic (*Ambulatório de Gastroenterologia*) of *Hospital de Clínicas* – UNICAMP, located in the city of Campinas, state of São Paulo, Brazil.

The control group was composed of individuals from the community of the cities of Limeira and Campinas – São Paulo, Brazil. Healthy volunteers were evaluated in the Laboratory of Nutritional Assessment (LANUT) of the School of Applied Sciences – UNICAMP, and in the Laboratory of Investigation on Metabolism and Diabetes (LIMED), located on the campus of University of Campinas.

Inclusion criteria for the control group were women, aged between 18 and 59 years, stable weight over the last six months (change of up to 5% in body weight), body mass index (BMI) <30 kg/m^2, without changes in diet for the last six months. Exclusion criteria for the control group were: pregnancy, patients with other diseases that affect the nutritional status and dietary intake (diabetes, dyslipidemias, cancer, AIDS, diseases of the gastrointestinal tract such as intestinal malformation, short bowel syndrome, irritable bowel syndrome, celiac disease, lactose intolerance, inflammatory bowel disease, and Crohn's disease), and neurological disorders affecting cognition and ability to answer the questions.

Inclusion criteria for the case group were women, aging between 18 and 59 years, confirmed diagnosis of IBS according to the ROME III criteria, and not being under nutritional monitoring. Exclusion criteria for the case group were pregnancy, diseases that affect the nutritional status, and dietary intake, and neurological status.

Anamnesis

It was collected information on personal medical history and family history concerning gastrointestinal-related diseases such as fibromyalgia, chronic fatigue syndrome, temporomandibular joint dysfunctions, chronic pelvic pain, ulcer dyspepsia, and use of laxatives and antidiarrheal medications.

Life habits

The level of physical activity was assessed by the International Physical Activity Questionnaire (IPAQ)[26]. We applied a questionnaire on smoking, which has been classified as follows: smoker (smoked ≥100 cigarettes during life and currently smokes), former smoker (smoked ≥100 cigarettes and no longer smokes), and non-smoker (smoked <100 cigarettes the whole life)[27]. The consumption of alcoholic beverages was assessed in drinks as follows: less than 1 drink per month; 1 to 4 drinks per month; 5 to 7 drinks per month; and more than seven drinks per month[27]. Sleep was assessed based on the Epworth Sleepiness Scale, translated and validated to the Portuguese version[28]. We also questioned participants as for the presence of gastrointestinal symptoms in 42 foods deemed troublesome for IBS carriers[29].

Evaluation of quality of life

The "Irritable Bowel Syndrome Quality of Life Questionnaire" (IBS-QOL) was applied to evaluate quality of life using the translated version into Portuguese language. The IBS-QOL is an instrument composed of 34 items developed and validated for measuring health-related quality of life of patients with IBS. Its assessment comprises eight domains: dysphoria, interference with activity, body image, health concerns, food prevention, social reaction, sexuality, and relationships. The score of responses ranges from 1 to 5, resulting in an overall score of QOL and in each domain. Values close to 100 represent a better quality of life, while results close to 0 are related to the worst quality of life of patients with IBS[30].

Anthropometric assessment

Evaluation of weight occurred using a weighting scale (Welmy® W200) of 200-kg maximum capacity. Volunteers were standing, barefoot, with arms extended to the side of their bodies, and wearing light clothes for a proper measurement. Height was measured by a wall mount stadiometer. Body mass index was calculated and classified according to the criteria of the World Health Organization[31].

For measurement of waist circumference, patients were standing naked at the site of measurement, which occurred at the umbilical level. It was used a non-extensible measuring tape, and the reading was performed at the end of expiration. For the hip circumference, tape circled hip in the region of greater perimeter between the waist and the thigh[32]. We calculated the waist-to-hip ratio.

Statistical analysis

For statistical analysis we used the IBM SPSS program version 21.0. Average and standard deviation were used for describing parametric data, whereas medians and interquartile range were used for describing nonparametric data. Categorical data were presented in percentage values. We used the Kolmogorov-Smirnov test to evaluate the normality of the distribution of the studied variables. We used Student's *t*-test and Mann-Whitney test for comparing the two independent groups according to the normality of variables. Chi-square test was used to investigate the presence of associations between categorical variables. We calculated odds ratio for presence of diseases between cases and controls. The adopted significance level as a basis for decision was less than 5% ($P<0.05$).

RESULTS

Age and body adiposity

In TABLE 1 we can observe that the average age in both groups are within the same age group – middle-aged adults. There was significant difference in waist circumference ($P=0.043$) and hip circumference ($P=0.043$), evidencing greater metabolic diseases risk in the case group compared with the control group. However, when analyzing waist-to-hip ratio, there was no significant difference ($P=0.423$) between the groups. Since waist circumference and hip circumference are proportionately higher in the case group, there was no significant statistical difference for waist-to-hip ratio compared with controls. When analyzing BMI ($P=0.005$), we can observe overweight in the case group while in the control group we observe eutrophy.

TABLE 1. Comparison of age and profile of body adiposity for controls and cases.

Variables	Research group		*P* value
	Controls	Cases	
Age (years)	40±9	46±12	0.026[a]
IBS diagnosis time (years)	–	6±5	–
BMI (kg/m²)	24.7±2.8	28.4±6.7	0.005[a]
Waist circumference (cm)	85.4±8.7	92.1±16.6	0.043[a]
Hip circumference (cm)	100.9±9.4	106.1±11.5	0.043[a]
Waist-to-hip ratio	0.84±0.07	0.86±0.1	0.423[a]

Values are presented as mean ± SD (range). [a]Student's *t*-test. IBS: irritable bowel syndrome; BMI: body mass index.

Associated comorbidities and use of medicines

The case group showed the highest frequency of comorbidities associated with IBS when compared with the control group; $P<0.05$ (TABLE 2). In the odds ratio analysis it was identified greater chance for the development of these diseases in the case group compared with the control group. There was no significant difference in the frequency of ulcer dyspepsia ($P=0.47$) and use of laxatives among groups ($P=0.06$). Nevertheless, the cases presented a higher use of antidiarrheals compared with the control group ($P=0.008$).

TABLE 2. Frequency of presence of self-reported diseases and use of medicines for controls and cases.

Variables	Research group		*P* value	Odds ratio
	Controls n (%)	Cases n (%)		
Fibromyalgia	1 (2.8)	13 (38.2)	0.001[a]	21.6 (2.6–177.7)
Chronic fatigue syndrome	1 (2.8)	13 (38.2)	0.001[a]	21.6 (2.6–177.7)
Temporomandibular joint dysfunctions	5 (13.9)	19 (55.9)	0.001[a]	7.8 (2.4–25.1)
Chronic pelvic pain	2 (5.6)	20 (58.8)	0.001[a]	24.2 (4.9–118.0)
Ulcer dyspepsia	0 (0.0)	2 (5.9)	0.140[a]	0.5 (0.4–0.6)
Use of laxatives	2 (5.6)	7 (20.6)	0.060[a]	4.4 (0.8–22.9)
Use of antidiarrheals	0 (0.0)	6 (17.6)	0.008[a]	0.4 (0.3–0.6)

Values are presented as n (%) or odds ratio (range). [a]Chi-square test.

Life habits

Variables related to life habits are presented in TABLE 3. There was no statistically significant association between smoking ($P=0.189$), daytime sleepiness ($P=0.314$) and physical activity ($P=0.82$) with IBS. The frequency of the consumption of alcoholic beverages was lower in cases compared with controls ($P=0.011$).

TABLE 3. Comparison of smoking, consumption of alcoholic beverages, sleepiness scale, and physical activity for controls and cases.

Variables		Research group		*P* value
		Controls n (%)	Cases n (%)	
Smoking	Non-smoker	31 (86.9)	27 (79.4)	0.189[a]
	Former smoker	5 (13.9)	4 (11.8)	
	Smoker	0 (0.0)	3 (8.8)	
Consumption of alcoholic beverages	< 1 drink per month	17 (47.2)	28 (82.4)	0.011[a]
	1 to 4 drinks per month	13 (36.1)	5 (14.7)	
	5 to 7 drinks per month	5 (13.9)	0 (0.0)	
	> 7 drinks per month	1 (2.8)	1 (2.9)	
Daytime sleepiness		6±5	7±5	0.314[b]
Physical activity	Low	2 (5.6)	0 (0.0)	0.820[a]
	Moderate	34 (94.4)	34 (100.0)	
	High	0 (0.0)	0 (0.0)	

Values are presented as n (%) or mean ± SD (range). [a]Chi-square test. [b]Student's *t*-test.

Troublesome foods

In TABLE 4 we show the frequency of self-reporting of 42 foods deemed troublesome causing gastrointestinal aggravations in case and control groups. Thirty-three (78.5%) foods mentioned presented more reports of worsening regarding gastrointestinal symptoms for IBS patients compared with controls ($P<0.05$). There was significant difference in the average of total amount of troublesome foods ($P<0.01$) and in the frequency of exclusion of foods ($P<0.01$) between both groups. About 80% of patients with IBS excluded some food from the diet and the total amount of troublesome foods varied from 7 to 21 for those carriers of IBS.

TABLE 4. Comparison of troublesome foods for controls and cases.

Foods	Research group		*P* value
	Controls n (%)	Cases n (%)	
Apple	1 (2.8)	8 (23.5)	0.010[a]
Pear	1 (2.8)	6 (17.6)	0.038[a]
Peach	0 (0.0)	5 (14.7)	0.017[a]
Mango	0 (0.0)	13 (38.2)	<0.01[a]
Cherry	0 (0.0)	0 (0.0)	–
Nectarine	0 (0.0)	1 (2.9)	0.300[a]
Watermelon	3 (8.3)	12 (35.2)	0.006[a]
Honey	0 (0.0)	1 (2.9)	0.300[a]
Natural juice	2 (5.6)	9 (26.5)	0.016[a]
Artichoke	0 (0.0)	0 (0.0)	–
Beet	0 (0.0)	6 (17.6)	0.008[a]
Broccoli	3 (8.3)	14 (41.2)	0.001[a]
Cabbage	8 (22.2)	21 (61.8)	0.001[a]
Okra	1 (2.8)	6 (17.6)	0.038[a]
Garlic	1 (2.8)	6 (17.6)	0.038[a]
Onion	0 (0.0)	9 (26.5)	0.001[a]
Cauliflower	4 (11.1)	11 (32.4)	0.030[a]
Industrial tomato sauce	7 (19.4)	17 (50.0)	0.007[a]
Pea	0 (0.0)	4 (11.8)	0.034[a]
Chickpeas	4 (11.1)	8 (23.5)	0.168[a]
Lentils	1 (2.8)	5 (14.7)	0.075[a]
Beans	12 (33.3)	26 (76.5)	<0.01[a]
Milk	9 (25.0)	28 (82.4)	<0.01[a]
Ice cream	3 (8.3)	19 (55.9)	<0.01[a]
Yogurt	5 (13.9)	18 (52.9)	<0.01[a]
Condensed milk	0 (0.0)	19 (52.9)	<0.01[a]
Fresh cheeses	1 (2.8)	20 (58.8)	<0.01[a]
Wheat- or rye-based foods	5 (13.9)	19 (55.9)	<0.01[a]
White bread	7 (19.4)	14 (41.2)	0.047[a]
Whole wheat bread	2 (5.6)	6 (17.6)	0.112[a]
Pasta	2 (5.6)	13 (38.2)	0.001[a]
Rice	1 (2.8)	8 (23.5)	0.01[a]
Chocolate	2 (5.6)	19 (55.9)	<0.01[a]
Fried foods	6 (16.7)	24 (70.6)	<0.01[a]
Pizza	3 (8.3)	19 (55.9)	<0.01[a]
Pies and pastries	1 (2.8)	18 (52.9)	<0.01[a]
Coffee	1 (2.8)	13 (38.2)	<0.01[a]
Alcoholic beverage	3 (8.3)	7 (20.6)	0.143[a]
Beef	4 (11.1)	15 (44.1)	0.002[a]
Pork	1 (2.8)	12 (35.3)	<0.01[a]
Chicken	0 (0.0)	5 (14.7)	0.017[a]
Fish	0 (0.0)	2 (5.9)	0.140[a]
Total amount of troublesome foods	3±3	14±7	<0.01[b]
Food exclusion from the diet	25.0	79.4	<0.01[a]

Values are presented as % or mean ± SD (range). [a]Chi-square test. [b]Student's *t*-test.

Quality of life

Quality of life was worse in case group than in the control group. There was worse quality of life for the domains dysphoria, interference with activity, body image, health concerns, food prevention, social reaction, sexuality, relationships ($P<0.01$), and in the overall quality of life ($P<0.01$) for carriers of IBS, compared with the control group (TABLE 5).

TABLE 5. Comparison of overall quality of life and of each subdomain of the questionnaire of quality of life for IBS carriers, in groups and controls.

Domains	Research group		*P* value[a]
	Controls	Cases	
Dysphoria	81.6±23.7	67.0±25.2	<0.01
Interference with activity	71.3±29.9	47.2±24.3	<0.01
Body image	70.9±29.9	50.0±25.2	<0.01
Health concerns	66.6±32.0	45.1±25.7	<0.01
Food prevention	67.1±31.3	44.8±28.0	<0.01
Social reaction	83.7±41.0	74.8±56.5	<0.01
Sexuality	81.2±24.4	64.3±33.7	<0.01
Relationships	88.0±21.6	77.2±26.9	0.001
General score of quality of life	76.4±24.1	58.7±21.7	<0.01

Values are presented as mean ± SD (range). [a]Mann-Whitney test.

DISCUSSION

In our study we investigated the profile of body adiposity, life habits, self-reporting of troublesome foods, and the quality of life of women with IBS in comparison with a healthy control group. The main findings showed that IBS patients featured more general, abdominal, and gluteofemoral adiposity; higher frequency of comorbidities and use of antidiarrheals; less consumption of alcoholic beverages; higher frequency of self-reporting of troublesome foods and food exclusion from the diet; and worse quality of life when compared with controls.

We found positive association between IBS and increased volume of android fat, according to waist circumference, and gynoid, according to hip circumference, and general fat according to BMI. In literature there are studies with controversial results concerning the association of BMI with gastrointestinal symptoms[8-12,14,15,17,33,34]. In prospective studies, Aasbrenn M et al.[14] and Sadik R[35] demonstrated that visceral adiposity and waist circumference are associated with a significant increase in the risk of IBS, in addition to the association between increased severity of IBS symptoms and increase in BMI. A diet poor in fiber, and rich in saturated fat and fermentable carbohydrates may contribute to IBS symptoms in obese individuals[8]. Moreover, high BMI is related to increased colon transit and the consequent increase in gastrointestinal symptoms. In patients with overweight, colon and rectosigmoid transit were faster compared with eutrophic patients, and symptoms of pain/discomfort and swelling are also associated with abnormalities of the colon transit in obese patients with IBS[35]. On the other hand, a study conducted by Van Oijen et al.[36] with 1023 individuals reported that BMI alone does not predict the occurrence of gastrointestinal disorders and symptoms such as abdominal pain, diarrhea, and constipation. Authors of a recent study on a large sample of patients with IBS

and control individuals demonstrated that obesity is as much often found in IBS as in the general population[37]. The fact the control group has a BMI <30 kg/m² as inclusion criterion may have favored the findings of higher adiposity in case individuals, since the population of Brazilian adult women features an obesity prevalence of 18.7%[38].

In our study, we found a statistically significant difference in the presence of comorbidities associated with IBS. IBS is commonly manifested with other chronic painful disorders, such as dyspepsia, fibromyalgia, chronic fatigue syndrome, and temporomandibular joint dysfunctions[25,39]. A systematic-review study conducted by Whitehead et al.[40] found association of IBS with other non-gastrointestinal disorders, such as fibromyalgia (49%), chronic fatigue syndrome (51%), temporomandibular joint dysfunction (64%), and chronic pelvic pain (50%), suggesting that each disorder is the manifestation of varied combinations of physiological and psychological factors that interact. The use of antidiarrheals for those carriers of IBS was significantly higher compared with healthy individuals. An alternative as a second-line treatment for gastrointestinal symptoms of IBS is using laxatives and antidiarrheals[25]. The use of laxatives can promote constipation relief with improvement in quality of life, being well tolerated in adults and children, and it may contribute to change the consistency and shape of feces[41,42].

Among the analyzed parameters regarding life habits, consumption of alcoholic beverages showed significant difference between cases and controls. Patients with IBS have intolerance to several alcoholic beverages, and generally have low consumption of such due to aggravations to gastrointestinal symptoms such as abdominal pain and diarrhea caused by the change of intestinal permeability and motility[7,22]. Advice on healthy eating and lifestyle are recommended as first-line approach in the dietary handling of IBS, and the standard recommendation is to decrease the consumption of alcoholic beverages because of its association with gastrointestinal symptoms in IBS patients[43].

Most foods deemed troublesome in literature[29] and investigated in our study were reported as triggers of gastrointestinal symptoms in IBS carriers when compared with the healthy control group. Food intolerance is a frequent problem with significant consequences for individuals with IBS. Many patients with IBS associate eating some foods (such as dairy products, wheat-based products, spicy and fried foods, fruits and vegetables) with the onset and development of IBS symptoms, and about 62% of individuals have diet restrictions or exclusion[44,45]. These foods are rich in FODMAPs and IBS individuals are often intolerable to these carbohydrates[2,45]. According Mullin et al.[2], individuals who manifest adverse reactions to foods present worse quality of life and cases of anxiety or depression associated with IBS. Diets with low levels of FODMAPs, with different proportions of proteins, fats, and carbohydrates, can improve symptoms in patients by decreasing patterns of abdominal pain and bloating, and improve quality of life in more than half of patients with IBS[2,45-47].

In our study we noted worse overall quality of life in all studied domains in IBS patients compared with healthy individuals, being food prevention and health concerns the most affected subdomains in patients with the syndrome. IBS causes reduction of quality of life with the same degree of commitment as diabetes, congestive heart failure, kidney failure, and liver cirrhosis[48]. The QOL of patients with IBS was influenced by extraintestinal symptoms, such as sexuality, mood, and anxiety, in addition to the decrease in QOL concerning energy/fatigue, limitations to perform their daily activities at work, pain, overall perception of health, inability to follow an unrestricted diet, and worsening in relationships, aggravating the functional status and well-being of patients[4,49,50]. The fear of gastrointestinal aggravations is also a predictive of impairment of QOL, increased anxiety, and social isolation[5,6]. A clinically significant change in patients with IBS is seen from the therapeutic gain of ≥14 points in the IBS-QOL[5].

Certainly, there are limitations in our study. We conducted it in a secondary/tertiary healthcare scenario, which hinders the generalization of findings to the overall IBS population. As aforementioned, the fact the control group has a BMI <30 kg/m² may have favored the findings of higher adiposity in case individuals. Finally, the final sample size was small, which made separate analyses with each IBS phenotype impossible.

Therefore, in our case-control study conducted on adult women, IBS was associated with body adiposity, chronic painful disorders, food restriction, lower consumption of alcoholic beverages, and worst quality of life compared with healthy individuals, thus suggesting a demand of multidisciplinary health care towards this population. Confirmation of these data in other population extracts would assist in the comprehensive understanding of the clinical nutritional profile of these individuals, and may support interventions and handling of IBS.

ACKNOWLEDGEMENTS

We thank Prof. Cristiane Kibune Nagasako and Prof. Ciro Garcia Montes for assistance with data collection. We would also like to thank National Council for Scientific and Technological Development (CNPq) and São Paulo Research Foundation – FAPESP for funding the study.

Authors' contribution

Conceptualization: all authors. Methodology: Yamashita LM, Solar I, Santos LAO, Vasques ACJ. Formal analysis: Mendonça APM, Vasques ACJ. Funding acquisition: Vasques ACJ. Project administration: Vasques ACJ. Visualization: Mendonça APM, Yamashita LM, Vasques ACJ. Writing – original draft: Mendonça APM. Writing – review and editing: Yamashita LM, Vasques ACJ. Approval of final manuscript: all authors.

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Mendonça APM, Yamashita LM, Silva ED, Solar I, Santos LAO, Vasques ACJ. Estado nutricional, qualidade de vida e hábitos de vida em mulheres com síndrome do intestino irritável: um estudo caso-controle. Arq Gastroenterol. 2020;57(2):114-20.

RESUMO – **Contexto** – A síndrome do intestino irritável é uma desordem gastrointestinal crônica e funcional que pode causar dor abdominal e alteração do hábito intestinal, afetando o estado nutricional e a qualidade de vida. Sua prevalência é alta, acomete cerca de 10% a 15% da população geral em países desenvolvidos, sendo mais prevalente em mulheres do que em homens na proporção 2:1. **Objetivo** – O objetivo deste estudo foi comparar o perfil de adiposidade corporal, os hábitos de vida e a qualidade de vida de indivíduos portadores da síndrome do intestino irritável com um grupo controle saudável. **Métodos** – Estudo caso-controle com 70 mulheres, 34 com a síndrome do intestino irritável e 36 saudáveis. Foi aplicado o *Irritable Bowel Syndrome Quality of Life Questionnaire* para avaliação da qualidade de vida. A adiposidade corporal foi avaliada a partir do índice de massa corporal, circunferência da cintura e relação cintura-quadril. Foi investigado o auto-relato de sintomas gastrointestinais de alimentos considerados problemáticos para portadores da síndrome do intestino irritável e a presença de comorbidades típicas. A análise do estilo de vida incluiu a prática de atividade física, alcoolismo, tabagismo, sonolência diurna e exclusão de alimentos. Para análise estatística foi utilizado o programa IBM SPSS, com o nível de significância de 5%. **Resultados** – Houve maior acúmulo de adiposidade central e periférica no grupo caso em comparação ao grupo controle (P<0,05). Os casos apresentaram maior chance de desenvolver comorbidades associadas à síndrome do intestino irritável (P<0,05). Cerca de 80% dos pacientes com a síndrome do intestino irritável excluíram algum alimento da dieta (P<0,01) e o total de alimentos problemáticos pode variar de 7 a 21 alimentos (P<0,01). Grupo caso apresentou pior qualidade de vida para o escore geral e para todos os domínios avaliados (P<0,05). **Conclusão** – Em comparação aos controles, as mulheres portadoras da síndrome do intestino irritável apresentaram maior adiposidade corporal, maior frequência de comorbidades, maior restrição ao consumo de alimentos considerados problemáticos e pior qualidade de vida.

DESCRITORES – Síndrome do intestino irritável. Adiposidade. Estilo de vida. Qualidade de vida.

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Low FODMAP: A Preliminary Strategy to Reduce Gastrointestinal Distress in Athletes

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ABSTRACT

LIS, D. M., T. STELLINGWERFF, C. M. KITIC, J. W. FELL, and K. D. K. AHUJA. Low FODMAP: A Preliminary Strategy to Reduce Gastrointestinal Distress in Athletes. *Med. Sci. Sports Exerc.*, Vol. 50, No. 1, pp. 116–123, 2018. **Introduction**: Gastrointestinal (GI) distress in endurance athletes is prevalent and detrimental to performance. Adverse GI symptomatology can be analogous with irritable bowel syndrome, where fermentable oligosaccharide, disaccharide, monosaccharide, and polyols (FODMAP) reduction has demonstrated efficacy. This study investigated the effects of low FODMAP (LFOD) diet on GI distress parameters in runners with a history of nonclinical exercise-associated GI symptoms. **Methods**: Eleven recreationally competitive runners (five men, six women; 5-km personal best 23:00 ± 4:02 min:s) participated in the study. Runners were allocated to a randomized 6-d LFOD or high FODMAP (HFOD) diet separated by a 1-d wash-out in a controlled, single-blinded cross-over study. In each period participants completed two strenuous running sessions consisting of 5 × 1000 m and a 7-km threshold run. GI symptoms (during-exercise and daily) and the Daily Analysis of Life Demand for Athletes questionnaires were completed. Area under the curve was calculated for daily GI symptoms across each dietary period and analysis was conducted using multilevel mixed-effects linear regression for comparison between the two diets. **Results**: A significantly smaller area under the curve for daily GI symptoms 6 d during the LFOD compared with HFOD (mean difference, −13.4; 95% confidence interval, −22 to −4.60; $P = 0.003$) was observed. The daily GI symptoms that were significantly lower during LFOD were flatulence ($P < 0.001$), urge to defecate ($P = 0.04$), loose stool ($P = 0.03$), and diarrhea ($P = 0.004$). No significant differences in during exercise symptoms or Daily Analysis of Life Demand for Athletes responses were observed between diets ($P > 0.05$). **Conclusions**: Preliminary findings suggest that short-term FODMAP reduction may be a beneficial intervention to minimize daily GI symptoms in runners with exercise-related GI distress. **Key Words:** GASTROINTESTINAL DISTRESS, EXERCISE, DIET, SHORT-CHAIN CARBOHYDRATES, ATHLETE, RUNNER'S TROTS

Optimal athletic performance can be directly compromised by gastrointestinal (GI) dysfunction (1). High rates of GI distress are reported to occur in 30% to 50% of endurance athletes (2,3). Although most symptoms occurring are mild to moderate, severe symptoms may impair training capacity and performance (2). During strenuous exercise GI symptoms are triggered in part by significant splanchnic hypoperfusion, as blood is shunted away from the GI tract toward the working muscles, which instigates acute enterocyte injury, increased intestinal permeability and altered motility (4). Symptoms associated with exercise-induced GI distress are numerous, but many are analogous with clinical indications associated with irritable bowel syndrome (IBS) (4,5). In particular, lower abdominal symptoms, such as diarrhea, bloating, abdominal pain, and flatulence, share remarkable similarities in both conditions. Interestingly, fermentable oligosaccharides, disaccharides, monosaccharides, and polyols (FODMAP) restriction has been emerging as an efficacious treatment for IBS symptoms (5–8). Therefore, it is plausible that FODMAP manipulation may also positively affect exercise-associated GI symptoms (9,10).

Nutritionists and athletes employ various dietary strategies to reduce exercise-associated GI distress, including limiting dietary fiber and lactose, eating low-residue foods around competition, training the gut to tolerate larger carbohydrate loads or removing gluten (11,12). A gluten-free diet has become a popular regimen to supposedly alleviate exercise-associated in nonceliac athletes (13) and IBS-related GI symptoms (14) although negligible peer-reviewed evidence exists supporting these anecdotal claims (13). Conversely, data in nonathlete clinical populations propose that GI symptom improvement associated with gluten elimination may actually be modulated by the subsequent reduction in FODMAP content that generally accompanies a gluten-free diet, and not necessarily gluten elimination itself (3,15). A low FODMAP (LFOD) diet is predicted to be the next popular equivalent to the gluten-free diet (16).

FODMAP are poorly absorbed short chain carbohydrates that have been shown to increase osmotic load in the small

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Submitted for publication February 2017.
Accepted for publication August 2017.

0195-9131/18/5001-0116/0
MEDICINE & SCIENCE IN SPORTS & EXERCISE®

DOI: 10.1249/MSS.0000000000001419

intestine and colonic gas volume, which instigates adverse symptoms in hypersensitive individuals (10). Examples of foods restricted with a LFOD diet include lactose-containing products, such as cow's milk, a range of fruit high in fructose, wheat-based products, onions and garlic encompassing fructans and galactooligosaccharides, and fruits with stones (pits) or confectionary with naturally occurring or added polyols. In Western diets, up to 40 g of undigested carbohydrates reach the colon daily (17) including an average of 1 to 10 $g \cdot d^{-1}$ of inulin and oligofructans (18). In sensitive individuals, FODMAP can cause adverse GI symptoms. FODMAP are also important dietary constituents offering favorable prebiotic effects, such as acting as a substrate for beneficial microbial populations, increasing stool bulk, enhancing micronutrient absorption, and immune function (19), so unnecessary restriction is not advocated. To date, studies suggest that healthy individuals without IBS would not benefit from restricting FODMAP intake (9,20) and a prolonged strict LFOD diet does not appear to be a common practice among athletes (21). However, in athletes looking to reduce GI symptoms, self-reported data indicate that over half eliminate high FODMAP (HFOD) foods, without necessarily realizing that these foods were considered part of the FODMAP family (21). Eighty-six percent of these athletes report subsequent symptom improvement (21). Therefore, it is plausible that the physiological mechanisms and symptoms associated with exercise-associated GI injury increase sensitivity to all, or some FODMAP and it is relevant to consider if symptoms could be reduced with FODMAP restriction in endurance athletes.

We have recently published a case study showing positive outcomes of a LFOD dietary intervention in a multisport athlete (22). Based on these results, and encouraging clinical research on LFOD diets (10), it is imperative that the manipulation of short-chain carbohydrate be investigated as a novel tool for individualized dietary management aimed at attenuating GI distress in a group of healthy athletes. Hence, the purpose of this preliminary study was to examine the effect of a LFOD versus a HFOD diet on symptoms of self-reported GI distress and perceived well-being in clinically healthy recreationally competitive runners with a history of GI symptoms. Our *a priori* hypothesis was that a short-term LFOD diet would reduce the severity of GI symptoms appearing daily and during strenuous running sessions.

METHODS

Participants. Eleven recreational competitive runners (>25 km running per week) age 18 to 50 yr with self-reported persistent exercise-associated GI symptoms were invited to participate in this study. Inclusion criteria included: a minimum of three chronic exercise-associated GI symptoms (e.g., nausea, bloating, diarrhea) with score greater than 4 (quite often) on the background GI questionnaire (23), a habitual HFOD intake of ≥20 g FODMAP per day (24) as assessed with the Complete Nutrition Assessment Questionnaire (http://www.cnaq.com.au/) (25) and the capacity to complete two consecutive days of prescribed strenuous running training during the study. Exclusion criteria included a history of food intolerance (e.g., diagnosed lactose intolerance), known celiac disease or known familial history of celiac disease, clinically diagnosed nonceliac gluten sensitivity or IBS, current adherence to any special diet, or any preexisting medical condition that could be affected by dietary intervention. The dietary intervention periods were purposefully scheduled to avoid the potential influence of hormone changes over the menstrual cycle for the female runners. Ethics approval was obtained from the Tasmanian Health and Medical Human Research Ethics Committee (H0015151). All participants provided signed informed consent.

Experimental design. Using a single-blind, crossover design, participants were randomized to receive either a HFOD or a LFOD diet for 6 d, separated by a 1-d washout, followed by the alternative diet (Fig. 1). Randomization was generated using GraphPad QuickCals software. Participants were informed that they would be assigned "Specific Carbohydrate Diet A or B" for the first dietary period then the alternate diet for the subsequent dietary period, with no specific reference to FODMAP or gluten. Participants self-selected their training schedule based on study guidelines (see details below). All trainings were replicated during the subsequent dietary period. Participants were asked to record their daily exercise, food intake, and complete a postexercise GI questionnaire, daily GI questionnaire and Daily Analysis of Life Demands (DALDA) questionnaire each day throughout the two dietary periods.

Food preparation and provision. Participants were provided with premade frozen lunch and dinner meals (prepared, weighed, and frozen in a commercial kitchen; Matson's Catering, Launceston, Australia), breakfast (cereals, breads, milk, yoghurt), and snack foods (muesli bars, crackers). Because the study participants were blinded, all food was packaged in the same opaque containers and labeled according to each dietary period (e.g., week 1, muesli bars; day 2, lunch). Alongside the controlled study food provisions, the participants were able to self-select from a suggested list (of *choose* and *avoid*) and supplement the study food with fresh fruits, vegetables, and nuts with the stipulation that a counterpart substitution be exchanged in the second dietary period. A registered dietitian (lead researcher) provided dietary education to the participants on nutrition intake recording and appropriate food selections. The LFOD and HFOD meals were established based on previous research (20), Monash University's LFOD diet resources (http://www.med.monash.edu/cecs/gastro/fodmap/) and typical athlete diets (26). Recipes for LFOD and HFOD were similar, but ingredients were modified to alter the FODMAP content (Table 1). Meals were matched for content of total energy, protein, carbohydrate, fat, and fiber; however, resistant starch information was not available due to the absence of comprehensive resistant starch food composition tables. Each meal was analyzed for FODMAP

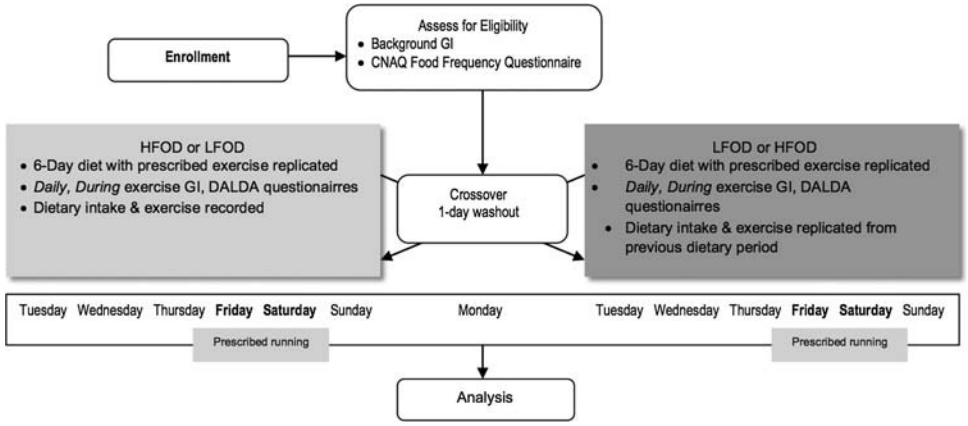

FIGURE 1—Schematic showing participant selection and study design.

content using a FODMAP-specific database (Monash University, FoodWorks Professional 7, Xyris, Brisbane, Australia) to ensure that LFOD meals contained less <0.5 g FODMAP per meal (27). An example of the study meals for each diet is provided in Table 1. The prototype study menu presented a macronutrient profile containing 5 to 7 $g \cdot kg^{-1}$ carbohydrate, 1.2 to 1.7 $g \cdot kg^{-1}$ protein, and 0.8 to 1.2 $g \cdot kg^{-1}$ fat (26) (FoodWorks Professional 7).

Exercise and prescribed running. Participants self-selected their training schedule based on study guidelines which indicated: days 1 and 2 to be light- to moderate-intensity training, day 3 to be rest or very light nonrunning exercise (e.g., yoga, swimming). Days 4 and 5 were prescribed very intense running sessions, and day 6 was entirely self-selected exercise or rest. Day 4 (interval session) consisted of a 10-min self-prescribed warm-up with increasing intensity, 5 × 1000 m interval pace (100% of predicted $v\dot{V}O_{2max}$) with 3-min brisk walk or light jog between intervals followed by a 10-min self-selected cooldown. Day 5 (threshold session) consisted of a 7- to 10-min self-selected warm-up with increasing intensity, 7 km at threshold pace (~90% of predicted $v\dot{V}O_{2max}$) followed by a 10-min self-selected cooldown. Prescribed running sessions were individually monitored using participants' personal Garmin GPS running watches (Forerunner® 735XT, 630XT, 235, or 910XT), and all trainings were replicated in the second intervention period. Interval and threshold paces were individually prescribed based on calculations from a recent race performance using VDOT (velocity at $vV0_{2max}$) tables (28). Running sessions were completed on flat terrain, at the same time of day (±30 min) over the period of data collection (December 2015 to February 2016).

TABLE 1. Example of high and low FODMAP diets.

Meal	LFOD Diet	HFOD Diet
Breakfast	LFOD muesli[a]	Muesli with dried fruit and nuts
	Lactose-free milk	Milk
	Blueberries	Apple
	Coffee/tea with lactose-free milk	Coffee/tea with milk
Snack	Corn Cruskits	Rye Cruskits
	Lactose-free yogurt	Yogurt
	Grapes	Nectarine
Lunch	Maple glazed salmon on quinoa/rice pesto pasta[b]	Honey-glazed salmon on durum wheat pesto pasta[c]
Snack	Gluten-free biscuits	Wheat biscuits
	Cheddar cheese	Cheddar cheese
	Tomato, cucumber	Snap peas, cucumber
Dinner	Grilled chicken and vegetables on quinoa[d]	Grilled chicken and vegetables on couscous[e]
Snack	Lactose-free yogurt	Yogurt
	Strawberries	Cantaloupe
	Coffee/tea with lactose-free milk	Coffee/tea with milk

[a]LFOD muesli made with rice crispies, corn flakes, quinoa flakes, shredded coconut, and pumpkin seeds.
[b]LFOD pesto pasta made with: cherry tomatoes, eggplant, garlic infused oil, pine nuts, basil, parsley.
[c]HFOD pesto pasta made with: cauliflower, asparagus, pistachios nuts, basil, parsley, garlic.
[d]LFOD vegetables included: small portion sweet potato, red bell pepper, spinach.
[e]HFOD vegetables included: larger portion of sweet potato, beetroot, garlic, red onion.

GI symptom monitoring. During-exercise GI questionnaires and daily GI questionnaires were used to assess the occurrence and severity of upper and lower abdominal symptoms determined using a 10-point scale ranging from 0 "no problem at all" to 9 "the worst it has ever been" (23). Section 1 of the questionnaire addresses upper abdominal symptoms: reflux, heartburn, burping, bloating, stomach pain/cramps, vomiting, and nausea. Section 2 addresses lower abdominal symptoms: flatulence, urge to defecate, left abdominal pain (side stitch), right abdominal pain (side stitch), loose stool, diarrhea, and intestinal bleeding (23). Diarrhea criterion was defined as an increase in the number of bowel movements per day compared with the participants usual bowel habit. Participants completed the during-exercise GI questionnaire immediately after their training session and the daily GI questionnaire at the end of each day at the same time. The GI symptom scores were tabulated for each day and exercise session (23). Mean scores for daily GI symptoms, during-exercise GI symptoms, and incremental area under the curve (AUC) for daily GI symptoms across all 6 d of each dietary period were compared between the diets.

Perceptual well-being monitoring. Participants completed the DALDA questionnaire at the end of each day. This questionnaire is used to assess general stress levels (part A)

TABLE 2. Composition of dietary intake during the HFOD and LFOD dietary periods.

Dietary Component	HFOD	LFOD	*P*
Total energy (kcal)	3181 ± 403	3198 ± 429	0.724
Total carbohydrate (g)	323 ± 63	327 ± 67	0.569
Total protein (g)	158 ± 16	153 ± 20	0.030*
Fat (g)	130 ± 12	137 ± 15	0.003*
Fiber (g)	32 ± 5	30 ± 5	0.318
Total FODMAP (g)	41.4 ± 7.9	8.1 ± 3.5	<0.0001*
Excess fructose (g)	1.9 ± 0.54	0.5 ± 0.4	<0.0001*
Lactose (g)	28.0 ± 8.6	0.9 ± 0.3	<0.0001*
Total oligosaccharides (g)	8.7 ± 1.9	5.5 ± 3.2	0.001*
Fructooligosaccarides (g)	7.3 ± 1.8	4.5 ± 2.7	<0.001*
Galactooligosaccarides (g)	1.4 ± 0.3	1.0 ± 0.5	0.006*
Total Polyols (g)	2.9 ± 0.9	1.3 ± 0.7	<0.0001*
Sorbitol (g)	1.8 ± 0.9	0.9 ± 0.4	0.001*
Mannitol (g)	1.1 ± 0.3	0.4 ± 0.5	<0.0001*

*Significance between HFOD and LFOD ($P < 0.05$).
Energy, macronutrients and fiber were calculated using FoodWorks dietary software, which is based on the Australian Food Composition tables. Total FODMAP = excess fructose + lactose + sorbitol + mannitol + fructans + galactooligosaccharides. Bold text indicates additive constituents for total FODMAP. Data are presented as group ($n = 11$) mean ±SD for HFOD and LFOD.

and to determine stress-reaction symptoms (part B) using a rating scheme of "worse than normal," "normal," or "better than normal" for variables. Scores were tabulated and the "worse than normal" and "better than normal" scores compared between the two dietary periods.

Statistical analysis. All GI symptoms and DALDA scores and dietary variables were treated as continuous data (29) and compared between the two diets using multilevel mixed-effects repeated measure linear regression adjusted for order and period effects (Stata 13.0, StataCorp LP, College Station, TX). Regression residuals were tested for assumptions of linear regression (heteroscedasticity, skewness, kurtosis or linearity). Where regression residuals did not meet the assumptions of linear regression the analyses were repeated with multilevel mixed-effects ordered logistic regression. For consistency, all comparison results are presented as mean difference (95% confidence interval [CI]). For each dietary intake variable, the mean ± SD was calculated and compared between the diets using mixed-effects ordered logistic regression. *P* values ($P < 0.05$) are from the relevant analyses (linear regression or ordered logistics regression in case of violation of linear regression assumptions). Incremental AUC, above zero, for daily GI symptoms was calculated from total daily GI symptom scores over each 6-d diet (GraphPad Prism, version 6.0, San Diego, CA) and compared between the two diets.

RESULTS

Participants details and compliance. Dietary intake (Table 2), GI symptom assessment (Fig. 2), and DALDA results were available for 11 of 12 participants (five men, six women; 41 ± 10 yr; weight, 69.0 ± 12.0 kg; height, 171.1 ± 10.0 cm; 5 km personal best 23:00 ± 04:02 min:s). One participant was removed due to incomplete data. Background GI symptoms, primarily boating, flatulence, urge to defecate, and loose stool were predominant and were reported to occur *quite often* to *always* (score of ≥4 to 9). Total HFOD daily FODMAP intake was 43.8 ± 16.9 g FODMAP per day. The prescribed running sessions were completed as assigned, and exercise volume matched in each period (HFOD total exercise volume 50:12:43 h:min:s, 0:56:51 ± 0:25:33 daily mean ± SD; LFOD 50:36:42, 0:57:18 ± 0:23:55) with no significant differences in temperature (16.2°C ± 5.2°C vs 15.7°C ± 4.9°C) or humidity (64.0% ± 14.9% vs 55.3% ± 19.6%) for the LFOD or HFOD dietary periods, respectively.

All participants consumed the prescribed diets, and dietary intake was analyzed from food intake records for HFOD and LFOD. The composition of the diets is shown in Table 2. The two test diets were similarly matched for total energy, carbohydrate, and fiber. Protein and fat were statistically different between the diets ($P = 0.03$ and $P = 0.003$, respectively). These differences are of negligible clinical significance given the 5-g protein and 7-g fat daily variances. As designed, FODMAP intake differed significantly between the two diets being 41.4 ± 7.9 $g \cdot d^{-1}$ HFOD and 8.1 ± 3.5 $g \cdot d^{-1}$ LFOD ($P < 0.0001$).

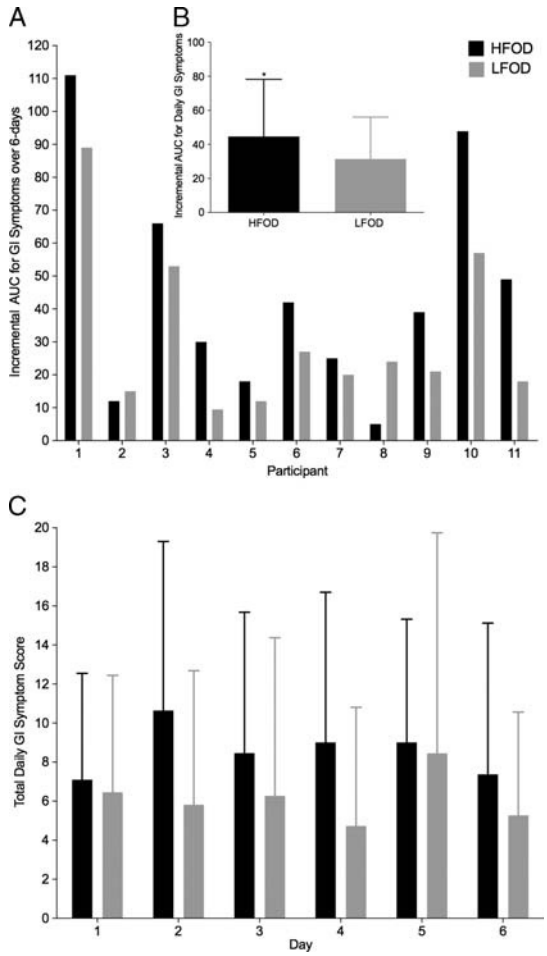

FIGURE 2—(A) Individual AUC for daily GI symptom scores over 6 d for LFOD vs HFOD ($n = 11$). (B) Mean group AUC during LFOD compared with HFOD for daily GI symptom scores. (C) Mean total daily GI symptom scores for each day (days 1–6) of the dietary period for all participants (error bars represent SD) on LFOD and HFOD ($P = 0.006$). *Significance ($P = 0.003$).

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GI symptoms: daily and during exercise. Daily GI symptoms scores were collected each day of the study and tabulated. Individual AUC responses show that 82.0% (9 of 11) of participants had a smaller AUC for daily GI symptom scores for 6 d during the LFOD compared with HFOD (mean difference, −13.4; 95% CI, −22 to −4.60; $P = 0.003$; Fig. 2A). The group AUC (Fig. 2B) was lower in LFOD (mean ± SD, 31.4 ± 24.6) compared with HFOD (44.6 ± 33.6). Specific daily GI symptoms that were reduced during LFOD included flatulence (mean difference, −1.12; 95% CI, −1.55 to −0.75; $P < 0.001$), urge to defecate (mean difference, −0.41; 95% CI, −0.81 to −0.02; $P = 0.04$), loose stool (mean difference, −0.38; 95% CI, −0.73 to −0.04; $P = 0.03$), and diarrhea (mean difference, −0.45; 95% CI, −0.75 to −0.14; $P = 0.004$). The mean GI symptoms scores for day 1 to day 6 were higher during HFOD compared with LFOD (mean difference, −2.45; 95% CI, −4.21 to −0.69; $P = 0.006$; Fig. 2C). No order or period effects were observed for total daily GI symptoms, during-exercise GI symptoms on any of analyzed variables except for loose stool (mean difference, −0.35; 95% CI, −0.79 to −0.01; $P = 0.03$).

During-exercise GI symptoms scores for the HFOD and LFOD dietary periods for days 4 and 5, when prescribed strenuous running sessions, were compared. Half of the participants rated GI symptoms during the prescribed running sessions to be moderate to severe (≥3). Burping was the one symptom that was significantly higher (mean difference, 0.30; 95% CI, 0.01–0.58; $P = 0.04$) during LFOD compared with HFOD. No significant differences in any other GI symptoms were found during the prescribed running sessions between HFOD and LFOD.

Perceptual well-being. Overall well-being was measured using DALDA and the worse and better than normal scores were compared for each dietary period, as well as the scores on the prescribed training days (days 4 and 5). Total worse than normal scores for stress (part A) and stress response (part B) combined were not different (mean difference, −0.45; 95% CI, −1.30 to 0.40; $P = 0.30$) during HFOD (3.71 ± 3.18) compared with LFOD (3.30 ± 3.31). Similarly, total better than normal scores for the HFOD (2.59 ± 2.80) and LFOD (2.97 ± 3.66) were not significantly different across each dietary period (mean difference, 0.43; 95% CI, −0.52 to 1.37], $P = 0.38$). Total worse than normal scores on day 4 or day 5 were not different (mean difference, −0.82; 95% CI, −2.26 to 0.63; $P = 0.30$; mean difference, −0.91; 95% CI, −2.35 to 0.53; $P = 0.25$, respectively). Total better than normal scores on day 4 or day 5 were not different (mean difference, 0.5; 95% CI, −1.11 to 2.11; $P = 0.55$; mean difference, 1.23; 95% CI, −0.39 to 2.84; $P = 0.10$, respectively). No order or period effects were observed for DALDA scores.

DISCUSSION

Dietary intake, and its interactions with strenuous exercise, is of particular importance to athletes because resulting GI distress is a common problem potentially impairing training capacity and performance (12). This is the first study to examine the effects of a short-term LFOD diet on GI symptoms and perceptual well-being in athletes with a history of exercise-associated GI distress. The aim of this preliminary study was to investigate if self-reported and case-study outcomes, demonstrating beneficial effects of FODMAP reduction on exercise-associated GI symptoms (21,22), could be substantiated in a larger cohort. Results from this preliminary study indicate that a LFOD diet had a positive effect on daily GI symptoms in 82% of the participants.

Effect of LFOD on daily GI symptoms. In participants with persistent exercise-associated GI symptoms, 9 of the 11 reported a reduction in daily GI symptoms on a short-term LFOD diet (Fig. 2). To date, LFOD diet research has predominantly focused on clinical populations, specifically individuals with IBS. Discernible symptomatic improvements in approximately 70% of IBS patients encourage the use of this diet as first line treatment (10). A limited number of investigations have included healthy controls (9,20,30), and results suggest that although healthy individuals demonstrate functional changes with FODMAP ingestion, GI symptoms remain very minor or nonexistent (20,30). Low-level GI symptoms likely have a negligible impact on athletic performance, but more moderate to severe symptoms may be detrimental (1). Although healthy populations, including healthy athletes, would be assumed to not benefit from FODMAP reduction with reduced GI symptoms, it is interesting to consider if the unique physiological, mechanical, and nutritional stress encountered by endurance athletes could increase susceptibility to any dietary triggers, such as FODMAP, for some of these athletes. GI symptoms are largely variable but our preliminary data suggest that a short-term LFOD diet may be efficacious in the management of daily GI symptoms (Fig. 2), particularly lower abdominal GI symptoms, in healthy athletes. Although changes in GI symptoms during exercise were not found, the ability to reduce daily GI symptoms would be very advantageous in extended events like the Tour de France, rigorous training camps, or multievent athletics, which feature sequential days of intensive and extensive exercise.

Effect of LFOD on exercise-specific GI symptoms. The GI symptoms during prescribed running sessions were similar for the HFOD and LFOD dietary periods. In race conditions, 4% to 32% of athletes report GI distress, and some symptoms are so severe that there is withdrawal from competition results (23). Numerous factors exacerbate GI symptoms during exercise including dietary intake/timing, mechanical impact, and physiological stress. Significantly greater GI issues are reported during prolonged events (e.g., Ironman), as compared with relatively shorter events, such as the marathon (23). Ingestion of carbohydrates as consumed in endurance sport, particularly solutions with a high osmolality, is associated with the development of GI symptoms during exercise (31). Exercise duration in the current study did not warrant carbohydrate ingestion; however, it is interesting to consider if ingestion of short-chain carbohydrates during exercise or preexisting FODMAP in the GI tract would have additive osmotic actions

and consequent symptoms (2). It is possible that the chosen exercise duration (45–60 min·d^{-1}), coupled with no CHO ingestion during exercise, curtailed any measurable difference in during-exercise GI symptoms between the diets. Timing of FODMAP intake may also influencing symptoms. In the present study, runners replicated their usual dietary patterns (e.g., timing) before exercise, which was fundamental in this research design to avoid altering habitual food intake timing and adding a confounding variable to the primary measure. Although this study did not investigate mechanistic hypotheses, it may also be conceivable that GI symptoms during exercise could be exacerbated with the presence of short-chain carbohydrates in the gut or during exercise FODMAP ingestion. In overall GI symptom reduction, our preliminary findings support further research of the hypothesis that FODMAP reduction would positively affect the severity or occurrence of exercise-associated GI symptoms.

Effects of altering FODMAP on perceptual well-being. Extreme and persistently high chronic training loads are associated with greater psychosomatic stress. Psychological well-being, personality traits and psychosocial factors, such as stress, also have the potential to influence perceptions of GI symptom presence and severity (32). The reverse may also occur, in that GI symptoms caused by exercise may be reflected by reductions in overall perceptual well-being. In the current study, DALDA evaluation was conducted alongside each dietary intervention with the aim to capture the relationship between perceptual well-being and GI symptoms influenced by diet and exercise stress. In athletes, the multifactorial nature of GI distress is well known, and the influence of psychological well-being or stress on alterations of the autonomic nervous system has been recognized (33,34). These changes in homeostatic balance have been characterized by slowing of gastric emptying, increased distal colonic motility, and acceleration of intestinal transit, further contributing to adverse GI symptoms (35). In the present study, it is possible that DALDA was not a sensitive enough tool to detect any FODMAP-related changes. A more chronic fatigue state over several days or weeks or longer is likely required to capture changes in DALDA responses (36).

Reflections for future studies. Dietary control was achieved, however, three reasons are suggested as to why no difference in GI symptoms were observed during the prescribed strenuous running sessions. First, daily GI symptoms on the LFOD diet were lower compared with HFOD. Lower preexercise symptomology during the LFOD may have skewed perceptions of the during-exercise GI symptoms toward being more exaggerated (greater net difference), resulting in reporting of higher during exercise symptom scores for LFOD. Second, although residual FODMAP are suggested to transit through the GI tract in less than 3 d (11), a longer period of LFOD may be necessary to augment further symptom reduction. Changes in the gut microbiome occur over time as the biomass evolves, and it is possible that the full benefits of the diet are not realized until 7 d (24) or a few weeks (10). Most importantly, exercise duration and climatic factors have been correlated with GI distress (23). Longer running sessions may be required to distinguish differences in GI symptoms between the diets. Although, the outdoor running climate throughout the current study was moderate with nominal variance between intervention periods, differences in climate and hydration status should be considered as influencers of GI symptoms. A greater effect may be observed under more extreme exercise conditions, and future research should consider this element in the methodology.

FODMAP manipulation considerations for the practitioner. Our developing work proposes that FODMAP manipulation may be an innovative addition to the sport nutrition practitioners' toolbox for management of exercise-associated GI distress. Certain considerations must be taken into account when trialing short-chain carbohydrate restriction with athletes because dietary requirements are individual and unnecessary food restriction may compromise optimal fueling (37). When appropriately planned, under the guidance of a dietetic professional, a LFOD diet can be matched for energy, macronutrients, and fiber (Table 2). Although differences in protein and fat intake were statistically significant between LFOD and HFOD, 7 and 5 g, respectively, these findings are not clinically significant. As a source of high-quality protein, cow-based dairy is often consumed by athletes at or above the general population recommendation of two to four servings per day. Coinciding high lactose intakes are likely (Table 2) and should be investigated as a primary trigger for GI symptoms with appropriate high-protein substitutes made, such as lactose-free milk if required. A LFOD diet should be considered once typical GI symptom triggers have first been assessed, such as lactose (11,12).

Intakes of prebiotic fructooligosaccharides and galactooligosaccharides, found in high amounts in wheat and legumes, are restricted with a LFOD diet, which is concerning. These prebiotics stimulate healthy colonic bifidobacterium. After 4 wk of a restricted fermentable carbohydrate diet, bifidobacteria populations were decreased in IBS patients (38). Immune health may be compromised with lower bifidobacterium count, which is an important consideration for overall athlete immunity and health (39). In athletes, it is unclear if risk associated with decreased healthy bacterial populations due to diet may be more or less apparent because exercise further alters diet–microbe–host metabolic interactions and may support higher gut microorganisms diversity (40). Exercise and an athletes' diet could offer a protective element against a decrease in healthy gut bacterial populations associated with FODMAP restriction. Given the restrictive nature and novelty of this dietary approach, a systematic and individualized approach will be obligatory for successful and efficacious implementation of a LFOD diet in an athletic setting.

CONCLUSIONS

Results from this study have shown that a short-term LFOD results in significantly lower daily GI symptoms over the intervention period compared with an HFOD diet in athletes with a self-reported history of persistent exercise-associated GI distress. Exercise-associated GI distress and pathophysiology of IBS are multifactorial, but both conditions feature similar symptomatology. Although, more work is needed to determine the effectiveness of a LFOD diet, our preliminary findings suggest that this dietary approach may be applicable beyond the clinical realm and offer a novel strategy to reduce GI symptoms in some symptomatic but otherwise clinically healthy athletes.

The authors would like to thank Monash University, Department of Gastroenterology, for assisting with FODMAP quantification. The King and Amy O'Malley Trust provided scholarship support. Isabelle Goodwin and Sarah Weber assisted with data input and food logistics. The results of this study are presented clearly, honestly, and without fabrication, falsification, or inappropriate data manipulation. The results of the present study do not constitute endorsement by ACSM.

Funding: This study was supported in part by the Canadian Sport Institute Pacific. No conflict of interest is present.

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A Diet Low in Fermentable Oligo-, Di-, and Monosaccharides and Polyols Improves Quality of Life and Reduces Activity Impairment in Patients With Irritable Bowel Syndrome and Diarrhea

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BACKGROUND & AIMS: **We investigated the effects of a diet low in fermentable oligo-, di-, and monosaccharides and polyols (FODMAPs) vs traditional dietary recommendations on health-related quality of life (QOL), anxiety and depression, work productivity, and sleep quality in patients with irritable bowel syndrome and diarrhea (IBS-D).**

METHODS: **We conducted a prospective, single-center, single-blind trial of 92 adult patients with IBS-D (65 women; median age, 42.6 years) randomly assigned to groups placed on a diet low in FODMAPs or a modified diet recommended by the National Institute for Health and Care Excellence (mNICE) for 4 weeks. IBS-associated QOL (IBS-QOL), psychosocial distress (based on the Hospital Anxiety and Depression Scale), work productivity (based on the Work Productivity and Activity Impairment), and sleep quality were assessed before and after diet periods.**

RESULTS: **Eighty-four patients completed the study (45 in the low-FODMAP group and 39 in the mNICE group). At 4 weeks, patients on the diet low in FODMAPs had a larger mean increase in IBS-QOL score than did patients on the mNICE diet (15.0 vs 5.0; 95% CI, −17.4 to −4.3). A significantly higher proportion of patients in the low-FODMAP diet group had a meaningful clinical response, based on IBS-QOL score, than in the mNICE group (52% vs 21%; 95% CI, −0.52 to −0.08). Anxiety scores decreased in the low-FODMAP diet group compared with the mNICE group (95% CI, 0.46–2.80). Activity impairment was significantly reduced with the low-FODMAP diet (−22.89) compared with the mNICE diet (−9.44; 95% CI, 2.72–24.20).**

CONCLUSIONS: **In a randomized, controlled trial, a diet low in FODMAPs led to significantly greater improvements in health-related QOL, anxiety, and activity impairment compared with a diet based on traditional recommendations for patients with IBS-D. ClinicalTrials.gov, number NCT01624610.**

Keywords: Nutrition; Functional Disorder; Psychology; Treatment.

Irritable bowel syndrome (IBS) is a common gastrointestinal (GI) illness of heterogeneous pathogenesis that is characterized by the presence of characteristic symptoms including abdominal pain and altered bowel habits.[1] Though IBS does not shorten life expectancy or identify patients at increased risk of developing other organic diseases such as colorectal cancer[2] or inflammatory bowel disease, it can profoundly affect the quality of life (QOL) of affected individuals.[3,4] Further validating the importance of IBS, affected patients consume substantially greater health care resources, undergo more surgical procedures, and have reduced work productivity with higher rates of both absenteeism and presenteeism than do persons without IBS.[5,6] Based on these facts, it is not surprising that IBS patients account for billions of dollars in direct and indirect health care expenditure each year in the United States.[7]

Abbreviations used in this paper: BMI, body mass index; CI, confidence interval; FODMAP, fermentable oligo-, di-, and monosaccharides and polyols; GI, gastrointestinal; HADS, Hospital Anxiety and Depression Scale; IBS, irritable bowel syndrome; IBS-D, irritable bowel syndrome with diarrhea; MCR, meaningful clinical response; mNICE, modified diet recommended by the National Institute for Health and Care Excellence; QOL, quality of life.

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1542-3565/$36.00
http://dx.doi.org/10.1016/j.cgh.2017.06.044

The reduced QOL reported in IBS patients extends across a wide range of domains as measured by validated generic and disease specific instruments. IBS patients report that their symptoms negatively affect their mood, body image, ability to eat an unrestricted diet, sexual functioning, relationships, and ability to conduct and enjoy their daily activities at work.[3,8,9] The decreases in QOL reported by IBS patients are undoubtedly influenced by a number of factors outside of their lower GI symptoms. For example, IBS patients have a substantially increased risk of comorbid functional GI disorders such as functional heartburn and functional dyspepsia, somatic pain conditions such as migraine headache, fibromyalgia, and interstitial cystitis,[10] and psychological distress including anxiety, depression, and somatization.[11] In addition, sleep disorders, which, similar to IBS, are known to exert negative effects on QOL, are reported more commonly in IBS patients than in otherwise healthy persons.[12,13] The reasons underlying the increased prevalence of GI and non-GI comorbidities in IBS patients remain poorly defined but central and peripheral gut-related mechanisms have been postulated.[14–16]

Up to two-thirds of IBS patients associate symptom onset or exacerbation with eating a meal.[17,18] Fermentable oligo-, di-, and monosaccharides and polyols (FODMAPs) are poorly absorbed, osmotically active,[19] short-chain carbohydrates that are rapidly fermented by colonic bacteria producing short-chain fatty acids and gases that can trigger symptoms in IBS patients through osmotic effects and luminal distention.[20] We and others have reported improvements in the main symptoms of IBS after dietary FODMAP restriction.[21–24] However, there are currently little data addressing the effects of the low-FODMAP diet on other aspects of the IBS illness experience including QOL, psychological distress, work productivity, or sleep.[25]

We hypothesized that a low-FODMAP diet would improve disease specific QOL, psychological distress, work productivity, and sleep to a greater degree than would standard dietary recommendations for IBS based on modified guidance from the National Institute for Health and Care Excellence (mNICE) in patients with IBS with diarrhea (IBS-D).

Methods

This was a randomized controlled superiority trial with a parallel design conducted in a 1:1 fashion. The primary GI symptom results from this trial are reported elsewhere.[24] In this manuscript, we report results from prespecified secondary endpoints addressing disease-specific QOL, psychological distress, work productivity, and sleep quality. The protocol was approved by the University of Michigan Hospital and Health Systems Institutional Review Board and registered with ClinicalTrials.gov (NCT01624610). All authors had access to the study data and reviewed and approved the final manuscript.

Patient Population

Adult patients meeting the Rome III criteria for IBS-D[26] (as assessed by a gastroenterologist) were consecutively recruited from the gastroenterology and primary care clinics at the University of Michigan and via local print and online advertising. Inclusion criteria included symptoms compatible with the diagnosis of IBS-D by the Rome III criteria and if relevant, a willingness to maintain a stable dosage of antidepressants during the study. Further inclusion and exclusion criteria are described in the Supplementary Materials.

Study Protocol

Eligible patients were asked to participate in a study that would test the efficacy of 2 diets thought to help IBS symptoms. Instruction regarding the 2 diet interventions was provided by specially trained research dieticians. In the hopes of mimicking real-world conditions, dietitians were not blinded to the study intervention though the investigators analyzing the data were blinded to randomization. After informed consent was obtained, potential subjects entered a 2-week screening period during which IBS symptoms were assessed. Further information about randomization and dietitian education can be found in the Supplementary Materials.

Prespecified Assessments:

Disease-specific QOL, anxiety and depression, activity impairment, and sleep quality were measured before and after the 4-week intervention. We utilized the IBS-QOL questionnaire, the Hospital Anxiety and Depression Scale (HADS), the Work Productivity and Activity Impairment questionnaire, and an 11-point numerical rating scale for sleep quality and fatigue. Further explanation of these instruments and prespecified comparisons can be found in the Supplementary Materials.

Statistical Analysis

The endpoints reported were collected from all patients at baseline and at the end of treatment, but the trial was not powered to detect these changes as this was a secondary analysis. Therefore, the presented analyses are considered to be exploratory in nature. Quantitative data are presented as mean ± SD unless otherwise stated. Baseline comparisons were made using an intention-to-treat analysis (chi-square test and Student *t* test) for categorical and continuous variables, respectively. Normality of the distribution was demonstrated with a folded F statistic. The 95% confidence intervals (CIs) for categorical outcomes were made by computing

confidence limits based on binomial proportions and risk differences within groups. The 95% CIs for continuous variables were computed utilizing Student's *t* test and paired *t* test. All patients who were randomized and who received dietary instructions were included in the responder comparisons, where dropouts were considered to be nonresponders (intention-to-treat analysis). For comparisons of questionnaire data at the end of the intervention period vs baseline, only patients who completed the intervention were included (per-protocol analysis). All statistical analyses were performed using SAS (version 9.4, SAS Institute, Cary, NC).

Results

Of the 171 subjects enrolled and screened between October 2012 and November 2015, 92 subjects (65 women [71%]; median age, 42.6 years [range, 19–75 years], 68 Caucasian [74%]) were deemed eligible and randomized (Supplementary Figure 1). Eighty-four patients completed the study period (45 low FODMAP, 39 mNICE); QOL data were obtained in 88 patients. There were more dropouts in the low-FODMAP arm (5 subjects) than the mNICE arm (2 subjects). Demographics (Table 1) and baseline QOL measures (Table 2) were similar between groups, except that there were more obese patients in the mNICE group.

The primary endpoint of adequate relief and other clinical endpoints have been reported previously.[24] Though there were no significant differences in the proportion of those reporting adequate relief ($P = .31$) or composite endpoint responders ($P = .11$), the low-FODMAP diet resulted in a significantly higher proportion of abdominal pain responders compared with the mNICE group (51% vs 23%; $P = .008$). There were similar significantly greater improvements observed in the low-FODMAP group for bloating, consistency, frequency, and urgency than in the mNICE group.

Table 1. Baseline Demographics

Characteristic	Low FODMAP (n = 50)	mNICE (n = 42)	*P* value
Age, *y*	41.6 ± 14.7	43.8 ± 15.2	.49
Patients per age group			.49
Aged 19–32 *y*	18 (36)	15 (35.7)	
Aged 33–49 *y*	18 (36)	11 (26.2)	
Aged 50–75 *y*	14 (28)	16 (38.1)	
Sex			.29
Female	33 (66)	32 (76.2)	
Male	17 (34)	10 (23.8)	
Race			.35
White	39 (78)	29 (69.1)	
Black	4 (8)	6 (14.3)	
Asian	0 (0)	3 (7.1)	
Latino	3 (6)	1 (2.4)	
Other	2 (4)	2 (4.8)	
Unknown	2 (4)	1 (2.4)	
BMI, kg/m^2	27.20 ± 6.12	31.70 ± 7.96	.003
BMI status			.18
Underweight (≤18.5 kg/m^2)	1 (2)	0 (0)	
Healthy weight (18.6–24.9 kg/m^2)	18 (36)	10 (24.4)	
Overweight (25–29.9 kg/m^2)	16 (32)	10 (24.4)	
Obese (≥30 kg/m^2)	15 (30)	21 (51.2)	
Employment status			.50
Currently working	33 (70)	26 (63)	
Not currently working	14 (30)	15 (37)	
Antidepressant medication			1.00
Taking	25 (50)	21 (50)	
Not taking	25 (50)	21 (50)	

NOTE. Values are mean ± SD or n (%).
BMI, body mass index; FODMAP, fermentable oligo-, di-, and monosaccharides and polyols; mNICE, modified diet recommended by the National Institute for Health and Care Excellence.

Nutritional Data

Baseline energy, nutrient, and FODMAP intake were similar between groups, but by the end of the 4-week study period, daily ingested total carbohydrates and measurable FODMAPs (fructose, lactose, monosaccharides, polyols) were significantly lower in the low-FODMAP arm compared with the mNICE arm.[24]

Disease-Specific QOL

The mean IBS-QOL score at 4 weeks improved significantly in both groups, but the magnitude of improvement was significantly greater in the low-FODMAP arm compared with the mNICE arm (15.9 vs 5.0 points; 95% CI, −17.4 to −4.3) (Figure 1*A*). In the low-FODMAP arm, significant improvements were observed in all IBS-QOL domains except for food avoidance (Figure 2). Improvements were seen in the mNICE arm as well for several domains (dysphoria, interference with activity, and health worry), but the magnitude of improvement in the low-FODMAP group was significantly greater for the dysphoria, interference with activity, body image, and social reaction domains. Interestingly, food avoidance did not significantly increase or decrease throughout the study for either group. At 4 weeks, the proportion of patients with at least 14-point improvement (meaningful clinical response [MCR]) was greater in the low-FODMAP group compared with the mNICE group (52% vs 21%; 95% CI, −0.52 to −0.08) (Figure 1*B*). The low-FODMAP group reached an MCR for the domains for dysphoria, interference with activity, body image, and social reaction; the mNICE group did not reach MCR for any IBS-QOL domains.

Anxiety and Depression

At 4 weeks, anxiety scores as measured by HADS improved significantly for subjects on the low-FODMAP diet (9.13 to 7.73; 95% CI, −2.10 to −0.59), whereas anxiety in the mNICE group did not change significantly (9.31 to 9.54; 95% CI, −0.64, 1.10) (Figure 3*A*). The

Table 2. Baseline Quality-of-Life Variables

Variable	Low FODMAP (n = 47)	mNICE (n = 41)	*P* value
IBS-QOL (Patrick, Drossman, et al)			
Overall	54.0 ± 18.4	54.4 ± 20.4	.93
Dysphoria	56.4 ± 25.0	56.4 ± 27.3	1.00
Interference with activity	47.0 ± 23.2	47.8 ± 23.8	.87
Body image	52.7 ± 21.0	48.9 ± 41.3	.44
Health worry	58.0 ± 24.1	63.1 ± 20.1	.29
Food avoidance	34.4 ± 26.3	35.8 ± 24.7	.80
Social reaction	60.5 ± 23.9	63.4 ± 23.6	.56
Sexual	68.8 ± 30.2	66.2 ± 56.9	.69
Relationship	69.1 ± 19.5	63.7 ± 26.9	.28
HADS (Mapi Research Institute)			
Anxiety score	9.0 ± 3.4	9.1 ± 4.3	.90
Depression score	4.4 ± 3.3	5.5 ± 3.9	.18
WPAI:SHP (Reilly Associates)			
Absenteeism	5.9 ± 13.3	1.6 ± 5.1	.09
Presenteeism	39.4 ± 23.3	35 ± 23.5	.48
Work productivity loss	41.5 ± 24.5	35.8 ± 22.8	.37
Activity impairment	50.7 ± 22.9	52.3 ± 26.2	.77
Modified sleep questionnaire	7.4 ± 2.1	7.7 ± 2.2	.44
NRS sleep and fatigue			
Sleep quality	5.4 ± 1.5	5.1 ± 1.6	.49
Fatigue	5.1 ± 1.9	5.4 ± 2.1	.41

NOTE. Values are mean ± SD.
BMI, body mass index; FODMAP, fermentable oligo-, di-, and monosaccharides and polyols; HADS, Hospital Anxiety and Depression Scale; IBS-QOL, irritable bowel syndrome-quality of life; mNICE, modified diet recommended by the National Institute for Health and Care Excellence; NRS, numerical rating scale; WPAI:SHP, Work Productivity and Activity Impairment Questionnaire for Irritable Bowel Syndrome.

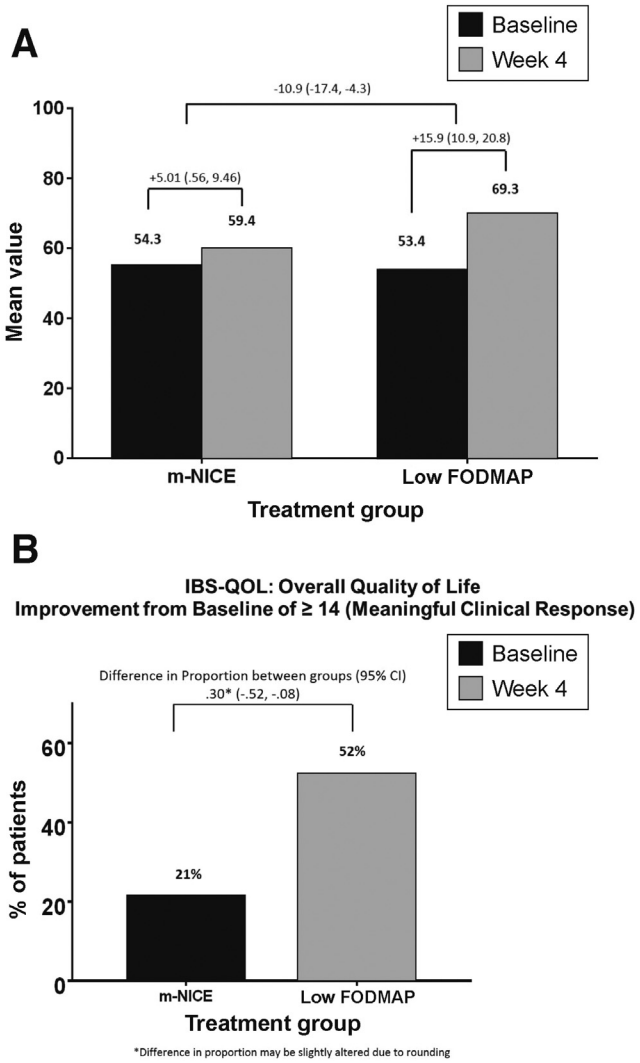


Figure 1. Inflammatory bowel syndrome–associated quality-of-life (IBS-QOL): overall QOL improvement from baseline of ≥14 (meaningful clinical response). (*A*) Comparison of IBS-QOL means (with 95% confidence interval [CI]) at baseline and week 4. (*B*) The proportion (with 95% CI) of patients improving by at least 14 points from baseline (meaningful clinical response) in IBS-QOL. FODMAP, fermentable oligo-, di-, and monosaccharaides and polyols; mNICE, modified diet recommended by the National Institute for Health and Care Excellence.

between-group difference in the magnitude of improvement in anxiety scores was also statistically significant (1.63; 95% CI, 0.46–2.80). The proportion of patients with anxiety scores (≤8) was not significantly different between the low-FODMAP group and mNICE arms (52%; 95% CI, 0.37–0.68 vs 37%; 95% CI, 0.21–0.53).

Depression scores improved in both groups compared with baseline, but were only significantly improved in the low-FODMAP arm (Figure 3*B*). The between-group difference in the magnitude of improvement in depression scores was not statistically significant (95% CI, −0.70 to −1.30). The proportion of patients with depression scores ≤8 was similar in the low-FODMAP group compared with the mNICE group (85%; 95% CI, 0.67–0.93 vs 80%; 95% CI, 0.73–0.96).

Work Productivity and Activity Impairment

Work Productivity and Activity Impairment scores collected at baseline and after the 4-week intervention demonstrated no significant improvement in absenteeism, presenteeism, or work productivity with either the low-FODMAP or mNICE diets (Table 3). However, whereas activity impairment scores at 4 weeks compared with baseline improved with both diet interventions, the magnitude of benefit reported by the low-FODMAP group was significantly greater than that reported by the mNICE group (13.50; 95% CI [2.72, 24.20) (Table 4).

Sleep and Fatigue

Compared with baseline, the mean sleep and fatigue scores at 4 weeks for the low-FODMAP group improved significantly, though the magnitude of change between the 2 groups was not statistically significantly different (95% CI, −0.29 to 1.20; 95% CI, −0.46 to 1.13, respectively) (Table 5). For sleep quality as measured by the modified sleep questionnaire, the low-FODMAP diet but

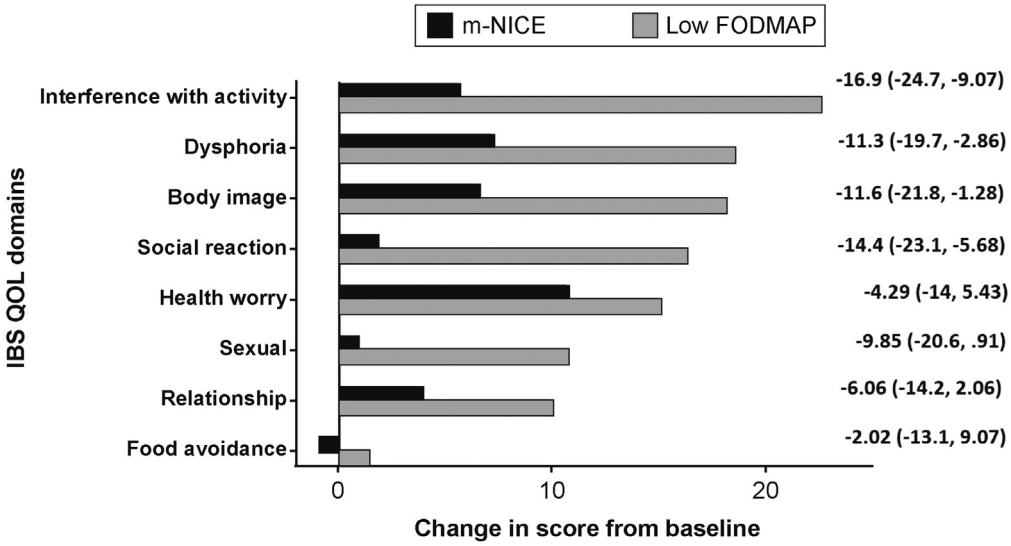
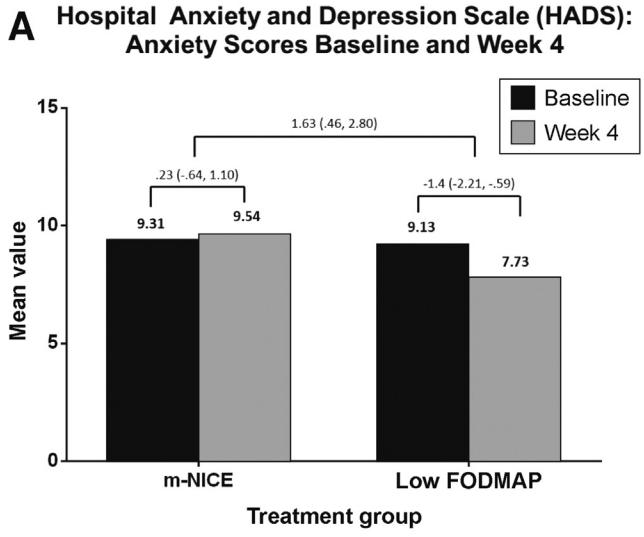


Figure 2. Inflammatory bowel syndrome–associated quality-of-life (IBS-QOL) subscore comparison of change in average score from baseline (with 95% confidence interval). FODMAP, fermentable oligo-, di-, and monosaccharaides and polyols; mNICE, modified diet recommended by the National Institute for Health and Care Excellence.



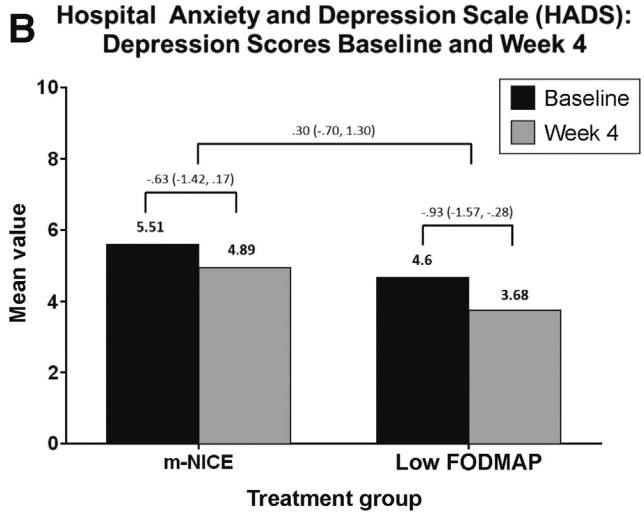


Figure 3. Hospital Anxiety and Depression Scale anxiety scores at baseline and week 4. (*A*) Anxiety score comparison (average score and 95% confidence interval) and (*B*) depression score comparison (average score and 95% confidence interval).

not the mNICE diet group experienced improvements in overall sleep quality (95% CI, −1.62 to −0.10; daytime fatigue; 95% CI, −0.56 to −0.07) and trouble falling asleep (95% CI, −0.65 to −0.03) at 4 weeks when compared with baseline. However, the difference between the two treatment groups was not significantly different (95% CI, −0.17 to 1.58; 95% CI, −0.09 to 0.61; 95% CI, −0.09 to 0.67).

Correlations

No correlation was detected between symptom response to dietary intervention (as measured by improvement in abdominal pain or by reporting of adequate relief of IBS symptoms) and improvement in QOL, psychological indices, or baseline antidepressant use.

Discussion

In this post hoc analysis of prespecified secondary outcomes, we found that the low-FODMAP diet led to significant improvements in QOL, anxiety, and activity impairment compared with a diet intervention based on mNICE guidelines. This work extends the benefits of the low-FODMAP diet beyond improving specific GI symptoms to more patient-centered outcomes.

Given that IBS is a symptom-based diagnosis, clinical trials have tended to focus on the ability of an intervention to improve the cardinal GI symptoms of IBS. Although improving GI symptoms is certainly important to IBS patients, focusing only on GI symptoms may fail to recognize the true impact of IBS on patient's daily lives and ability to function. In addition, it is clear that the illness experience of many IBS patients extends beyond their GI symptoms to include mental health issues[27] and sleep.[28] For these reasons, studies which take a holistic view of the impact of an intervention on

Table 3. Work Productivity Scores, Baseline vs Week 4

Variable	Low FODMAP			mNICE			Difference between groups[a]
	Baseline n = 25	Week 4 n = 24	Difference within group	Baseline n = 22	Week 4 n = 23	Difference within group	
Absenteeism (work time missed)	5.59 ± 14.00	5.10 ± 12.00	–0.74 (–3.86 to 2.38)	1.78 ± 5.00	6.47 ± 21.00	4.98 (–2.44 to 12.40)	5.72 (–1.86 to 13.30)
Presenteeism (impairment while working)	38.40 ± 23.00	26.30 ± 23.00	–13.30 (–24.20 to –2.43)	35.90 ± 25.00	33.04 ± 23.00	–1.36 (–16.30 to 13.56)	12.00 (–5.78 to 29.70)
Productivity loss (overall work impairment)	40.30 ± 24.00	28.30 ± 25.00	–13.30 (–24.80 to –1.86)	37.50 ± 24.00	34.50 ± 23.00	–1.40 (–14.60 to 11.80)	11.90 (–5.00 to 28.80)

NOTE. Values are mean ± SD or difference (95% confidence interval). A higher score is worse.
FODMAP, fermentable oligo-, di-, and monosaccharides and polyols; mNICE, modified diet recommended by the National Institute for Health and Care Excellence.
[a]Difference of the change in the average score from baseline at week 4 for low FODMAP and mNICE subjects.

Table 4. Activity Impairment, Baseline vs Week 4

Variable	Low FODMAP			mNICE			Difference between groups[a]
	Baseline n = 38	Week 4 n = 38	Difference within group	Baseline n = 36	Week 4 n = 36	Difference within group	
Activity impairment	52.60 ± 22.00	29.70 ± 24.00	–22.90 (–31.50 to –14.30)	52.80 ± 25.00	43.30 ± 28.00	–9.44 (–16.10 to –2.80)	13.50 (2.72 to 24.20)

NOTE. Values are mean ± SD or difference (95% confidence interval). A higher score is worse.
FODMAP, fermentable oligo-, di-, and monosaccharides and polyols; mNICE, modified diet recommended by the National Institute for Health and Care Excellence.
[a]Difference of the change in the average score from baseline at week 4 for low FODMAP and mNICE subjects.

Table 5. Mean Values for Selected Sleep- and Fatigue-Related Variables, Baseline or Week 2 vs Week 4

	Low FODMAP			mNICE			Difference between groups[a]
	Baseline n = 38	Week 4 n = 38	Difference within group	Baseline n = 37	Week 4 n = 37	Difference within group	
NRS questions							
Sleep quality	5.34 ± 2.00	4.38 ± 2.00	–0.96 (–1.47 to –0.46)	5.14 ± 2.00	4.61 ± 2.00	–0.53 (–1.06 to 0.00)	0.43 (–0.29 to 1.20)
Fatigue	5.06 ± 2.00	4.19 ± 2.00	–0.87 (–1.40 to –0.35)	5.44 ± 2.00	4.90 ± 3.00	–0.54 (–1.16 to 0.08)	0.33 (–0.46 to 1.13)
Modified Sleep Questionnaire							
Overall sleep QOL[b]	7.32 ± 2.00	6.42 ± 2.00	–0.90 (–1.62 to –0.17)	7.68 ± 2.00	7.49 ± 2.00	–0.19 (–0.70 to 0.33)	0.71 (–0.17 to 1.58)
Poor sleep quality	2.50 ± 1.00	2.26 ± 1.00	–0.24 (–0.55 to 0.07)	2.68 ± 1.00	2.59 ± 1.00	–0.08 (–0.33 to 0.17)	0.16 (–0.24 to 0.55)
Daytime fatigue	2.47 ± 1.00	2.16 ± 1.00	–0.32 (–0.56 to –0.07)	2.59 ± 1.00	2.54 ± 1.00	–0.05 (–0.31 to 0.21)	0.26 (–0.09 to 0.61)
Trouble falling asleep	2.34 ± 1.00	2.00 ± 1.00	–0.34 (–0.65 to –0.03)	2.41 ± 1.00	2.35 ± 1.00	–0.05 (–0.29 to 0.18)	0.29 (–0.09 to 0.67)

NOTE. Values are mean ± SD or difference (95% confidence interval).
FODMAP, fermentable oligo-, di-, and monosaccharides and polyols; mNICE, modified diet recommended by the National Institute for Health and Care Excellence; NRS, numerical rating scale; QOL, quality of life.
[a]Difference between the average change from baseline between groups at week 4 for low FODMAP and mNICE subjects.
[b]Sum of all 3 questions from the Modified Sleep Questionnaire, maximum possible score = 12.

QOL, mental health issues, daily functioning, and sleep are critical to understanding the true benefits of an intervention to an IBS patient's overall illness experience.

The low-FODMAP diet led to significantly greater improvements in disease-specific QOL than did the mNICE diet across all domains of the IBS-QOL questionnaire except food avoidance. For the IBS-QOL, a MCR has been defined as an increase in score of >14.[29] Patients randomized to the low-FODMAP diet were more than twice as likely to experience an MCR. Furthermore, those randomized to the low-FODMAP diet reached the threshold for an MCR for dysphoria, interference with activity, body image, and social reaction, whereas the MNICE group did not achieve an MCR for any individual IBS-QOL domains. These data demonstrate a profound effect of the low-FODMAP diet on IBS-specific QOL. We found the lack of effect of the low-FODMAP diet on food avoidance scores to be particularly interesting. The low-FODMAP diet is widely regarded to be highly restrictive and difficult for patients to adhere to, dissuading many from even attempting it. Our data, along with that from others,[30] suggest that the low-FODMAP diet may not be as burdensome to IBS-D patients as is widely perceived and is no more burdensome than traditional dietary advice offered to IBS patients.

There are very little other data addressing the impact of the low-FODMAP diet on QOL in IBS patients. In an unblinded, controlled trial of IBS patients from Denmark[31] who were randomized to the low-FODMAP diet (n = 42), a *Lactobacillus rhamnosus GG* probiotic (n = 41), or a usual Danish diet (n = 40), there were no statistically significant between-group differences in IBS-QOL scores at the end of the intervention period. However, significant improvements in IBS-QOL scores compared with baseline were observed with the low FODAMP diet but not the probiotic or usual Danish diet. The reasons for the differences in results between our study and the Danish study are not clear but might be attributable to differences in study populations (eg, our patient population was older [42 years of age] than were patients in the Danish study [37 years of age]), dietary habits between Denmark and the United States, or differences in study protocols.

There are increasing data to support a link between food, the microbiome, and mood.[32–34] In our study, the low-FODMAP diet led to statistically significant decreases in anxiety and depression scores at 4 weeks whereas there was no statistically significant improvement for the mNICE group. One issue that we cannot address in our study is whether anxiety state or trait improved. HADS is unable to distinguish between these 2 conditions and it is possible that although anxiety was improved by the low-FODMAP diet, patients could still have experienced anxiety, albeit to a lesser degree. Similar improvement in HADS scores (but not state anxiety or depression) were observed with a low-

FODMAP diet and gut-directed hypnotherapy in a recently published Australian study.[30] The mechanism(s) which underlie these observations are unclear, though one could plausibly suggest "top-down" or "bottom-up" models. It is entirely possible that by improving GI symptoms, patients felt less anxious about eating a meal. On the other hand, recent data have drawn a link between psychosocial distress, altered central processing, and modulation of nutrient-related visceral sensory signals.[30] Higher levels of psychiatric comorbidity are associated with higher preprandial and postprandial GI symptom burden in IBS patients.[14] Restriction of FODMAPs may improve psychiatric comorbidity,[35] through modulation of the gut microbiome or mucosal immune system.[36] Further studies to understand this interesting observation are warranted.

Decreases in work productivity and activity impairment are common in IBS and exact a significant toll on patients and society. Few IBS treatments have demonstrated benefits for these important outcomes.[37] The low-FODMAP diet led to a statistically significant improvement in absenteeism and presenteeism at 4 weeks when compared with baseline. However, between-group differences for absenteeism and presenteeism were not statistically significant. Though the low-FODMAP diet and the mNICE diet both led to statistically significant improvements in activity impairment at 4 weeks when compared with baseline, the magnitude of benefit with the low-FODMAP diet was significantly greater than the mNICE diet. This finding is consistent with the significant decrease in interference with activity subscale scores found on the IBS-QOL with the low-FODMAP diet vs the mNICE diet. Ours is the first study to show such robust benefits in activity impairment and validates the important downstream consequences of the low-FODMAP diet to patients with IBS-D.

Sleep disturbances are common in IBS patients and may well contribute to reductions in QOL, work productivity, and activity impairment.[12,13] In a preliminary assessment utilizing selected questions from the validated Sleep-50 Questionnaire, we found that the low-FODMAP diet improved overall sleep quality and fatigue at 4 weeks when compared with baseline. However, between group differences were not significantly different.

Our study has several important limitations. Although our endpoints were prespecified, the study was not powered for these secondary endpoints; thus, type II errors may have occurred and thus, our study should be viewed as more of an exploratory than definitive work. Also, the improvement noted in psychologic indices and disease specific QOL were measured at 4 weeks only, and may not necessarily translate into long term improvement (although long-term benefit for these endpoints has been noted in other studies).[30] Given that meals were not supplied to subjects, complete blinding was not possible, and bias might have been interjected by the dietitians or patients. Though awareness of the low-FODMAP diet has increased over time, it was relatively unrecognized in Michigan during the time this trial was conducted. In addition, rather than utilizing our clinical GI dieticians for this trial, we utilized a separate group of fully trained research dieticians to instruct study participants on the diet interventions in the hopes of reducing the likelihood of introducing bias toward one intervention or the other. We were careful to have the dieticians tell patients that they were to be randomized to 1 of 2 diet therapies for IBS (diet 1 or diet 2) and to avoid any discussion of efficacy or research conducted regarding either intervention. The short duration of the diet intervention could be viewed as a study limitation. However, the 4 week diet intervention period was chosen to reflect how the full FODMAP elimination phase is intended to be used in clinical practice, It should be remembered that the low-FODMAP diet plan consists of 3 separate stages: an elimination phase during which all FODMAPs are eliminated in the hopes of identifying IBS patients who are sensitive to FODMAPs, a reintroduction phase in which responders to the elimination phase undergo a structured reintroduction of foods containing individual FODMAPs in the hopes of identifying their specific triggers, and a maintenance phase in which information from the reintroduction phase is used to liberalize and tailor the diet thus creating each individual IBS patient's maintenance diet. Our study demonstrated benefits of the FODMAP elimination phase, which is only intended for short-term use, to symptoms and QOL in IBS-D patients. Subsequent studies will be required to better understand the reintroduction and maintenance phases of the low-FODMAP diet plan. Finally, although there was a significantly higher average body mass index (BMI) in the mNICE group, there were no significant differences between the groups in categorical BMI. Although there are no data to suggest that obese patients with IBS would respond differently to the 2 dietary interventions, it is possible that this imbalance could have introduced unintended bias. It is worth noting that there was no difference in response to either intervention between obese (BMI $\geq$30 kg/m^2) and nonobese patients (BMI $<$30 kg/m^2), acknowledging that our study was not designed or powered to adequately address this question.

In this US randomized, controlled trial, the low-FODMAP diet vs the mNICE diet demonstrated significant benefits for QOL, anxiety, and activity impairment in patients with IBS-D. This study is one of the first to extend the benefits of the low-FODMAP diet beyond improving GI symptoms in IBS patients, and, will hopefully prompt further investigation investigating the relationship of diet, GI symptoms, and QOL. When benefits for these important patient-centered outcomes are combined with the improvements in GI symptoms reported by our group and others, it is logical to conclude

that the low-FODMAP diet is an effective treatment intervention for patients with IBS-D.

Supplementary Material

Note: To access the supplementary material accompanying this article, visit the online version of *Clinical Gastroenterology and Hepatology* at www.cghjournal.org, and at http://dx.doi.org/10.1016/j.cgh.2017.06.044.

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Conflicts of interest
This author discloses the following: William D. Chey has served as a consultant for and received grant funding from Nestlé S.A., Sweden. The other authors disclose no conflicts.

Funding
Michigan Nutrition Obesity Research Center Grant (P30 DK089503), Clinical and Translational Science Award Grant (2UL1TR000433-06), Prometheus Therapeutics and Diagnostics (San Diego, CA).

Supplementary Information

Patient Population

Documentation of a normal colonoscopy or flexible sigmoidoscopy with normal colonic mucosal biopsies within 5 years as well as normal complete blood count, electrolyte panel, thyroid stimulating hormone, and a negative evaluation for celiac disease (tissue transglutaminase IgA, endomysial antibody, or duodenal biopsy) were also necessary to be eligible. Exclusion criteria included symptoms compatible with irritable bowel syndrome (IBS) with mixed or constipation subtype, comorbid medical problems affecting gastrointestinal transit/motility (eg, scleroderma, poorly controlled diabetes), inflammatory bowel disease, severe renal or hepatic disease, previous abdominal surgery (other than appendectomy, cholecystectomy [if $<$6 months prior to enrollment], and gynecologic or urologic surgery), and previous treatment with a low fermentable oligo-, di-, and monosaccharaides and polyols (FODMAP) diet. Pregnant patients and those currently taking probiotics, antibiotics, or narcotics were also excluded. Active participation in another form of dietary therapy at the time of enrollment (ie, gluten free, low carbohydrate, and high protein) was not allowed.

Methods

To be eligible for randomization, both an average daily abdominal pain score of 4 or higher on an 11-point numerical rating scale (0 = no pain, 10 = intolerable pain) and an average daily stool consistency, assessed by the Bristol Stool Form Scale, of $\geq$5 were required. IBS with diarrhea patients who fulfilled the entry criteria were randomized via computer generation in a 1:1 ratio to a low-FODMAP diet or modified diet recommended by the National Institute for Health and Care Excellence (mNICE) guidelines for IBS.

Randomized patients met with a trained research dietitian at the Michigan Clinical Research Unit and were counseled on their allocated diet. Patients were informed that they were going to be randomized to 1 of 2 dietary interventions for patients with IBS with diarrhea: diet 1 or diet 2. Using standardized instructions, the mNICE group was instructed to eat small frequent meals, avoid trigger foods, and avoid excess alcohol and caffeine. Foods containing FODMAPs were not specifically excluded as part of the mNICE instructions provided to study participants. For the low-FODMAP diet, instruction was administered in a standardized manner according to published materials from Monash University[1] but subjects were given teaching materials created from the University of Michigan. Dietary compliance measures used in the counseling environment included prospectively recorded 3-day food diaries. Food diaries were analyzed via the Nutrition Data System for Research computer program, measuring fructose, lactose, sucrose, pectins, sorbitol, and added sugars. At the completion of week 2, a second visit was conducted to answer questions, assess adverse events, and obtain information regarding dietary intake. At the completion of the 4-week study period, subjects met with the research dietitian to collect and assess the prospectively recorded 3-day food diaries and 24-hour dietary recall along with collection of quality-of-life (QOL) endpoints.

Prespecified Endpoints

The IBS-QOL questionnaire is a validated condition-specific quality-of-life measure for IBS with established internal consistency and reproducibility.[2–4] The IBS-QOL contains 41 descriptive IBS-specific quality of life items and uses a 5-point Likert-type response scale. A higher score on this scale correlates with a better QOL. Meaningful clinical improvement is seen by a change in IBS-QOL score $>$10–14.[3] This questionnaire was administered before and after the 4-week intervention. Improvements in mean scores, change in score, and proportion of subjects reporting 10- and 14-point improvement were compared between the 2 interventions.

Anxiety and Depression

To measure participants' anxiety and depression, the Hospital Anxiety and Depression Scale was used at baseline and at week 4.[5] The Hospital Anxiety and Depression Scale is a self-reported rating scale of 14 items used to identify and quantify depression and anxiety (7 items for each subscale). It is considered an effective screening measure for anxiety and depression and has been widely used.[6,7] It has 2 subscales, which evaluate anxiety and depression, with a higher score indicating more severe symptoms. The scores for each subscale range from 0 to 21; a cutoff score of 8 was used for each subscale. The proportion of patients reporting a score 8 or lower was compared between the 2 groups, as was the change in mean score from baseline.

Work Productivity and Activity Impairment

Health-related work productivity loss includes time lost from work (absenteeism) and reduced on-the-job effectiveness (presenteeism). The Work Productivity and Activity Impairment questionnaire measures work time missed and work and activity impairment because of a specified health problem during the past 7 days.[8] The Work Productivity and Activity Impairment IBS questionnaire consists of 6 questions and results in an overall work impairment (productivity loss) score, with higher scores indicating greater impairment.

Derived from the questionnaire are 4 metrics: absenteeism (the percentage of work time missed due to

health in the past 7 days), presenteeism (the percentage of impairment suffered while at work due to health in the past 7 days), overall work impairment (the total percentage of missed time due to absenteeism or presenteeism in the past 7 days), and activity impairment (the percentage of impairment suffered during daily activities in the past 7 days). Each metric varies from 0% to 100%, with higher scores indicating greater impairment. Only respondents currently employed (full-time, part-time, or self-employed) provide information on absenteeism, presenteeism, and overall work impairment (as one must be employed for health to affect work productivity). All respondents provide information on activity impairment. Both between-group and within-group scores were compared before and after dietary intervention.

Sleep and Fatigue

Sleep and fatigue were measured daily during the baseline and study period via an 11-point numerical rating system (0 = best, 10 = worst). In addition, 3 items from the modified Sleep-50 questionnaire were used to assess overall sleep quality ("Generally, I sleep badly," "I feel sleepy during the day and struggle to remain alert," and "I have difficulty falling asleep"), and was administered before and after the 4-week dietary intervention and scored from 0 to 3 (3 being the worst). The Sleep-50 questionnaire is designed to screen for multiple sleep disorders over the prior 4 weeks.[9] Difference-from-baseline scores were compared between groups.

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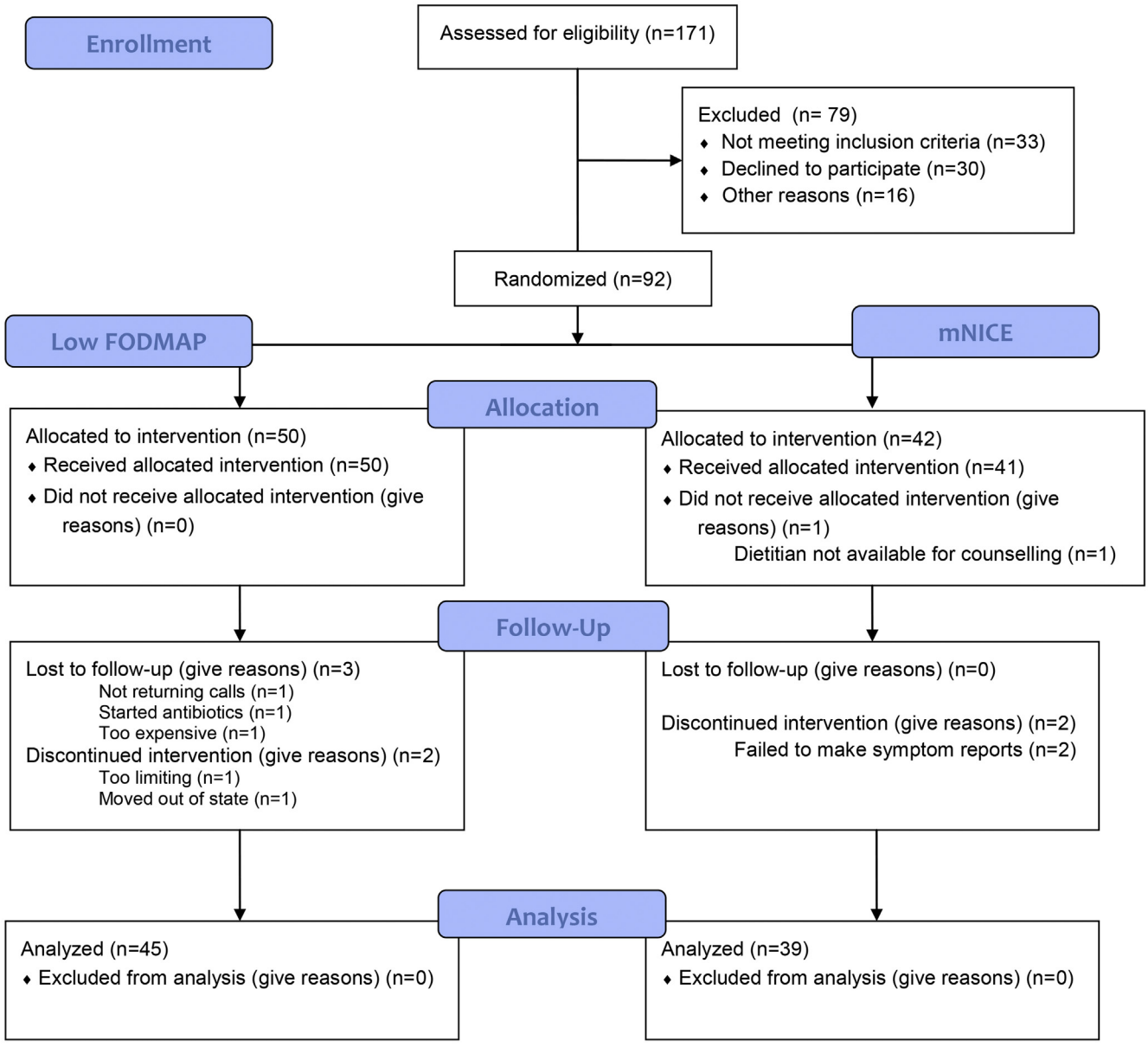

Supplementary Figure 1. CONSORT flow diagram. FODMAP, fermentable oligo-, di-, and monosaccharaides and polyols; mNICE, modified diet recommended by the National Institute for Health and Care Excellence.

Journal of the International Society of Sports Nutrition

RESEARCH ARTICLE Open Access

Effect of a short-term low fermentable oligosaccharide, disaccharide, monosaccharide and polyol (FODMAP) diet on exercise-related gastrointestinal symptoms

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Abstract

Background: Research has demonstrated that low fermentable oligosaccharide, disaccharide, monosaccharide and polyol (FODMAP) diets improve gastrointestinal (GI) symptoms in irritable bowel syndrome sufferers. Exercise-related GI issues are a common cause of underperformance, with current evidence focusing on the use of FODMAP approaches with recreationally competitive or highly trained athletes. However, there is a paucity of research exploring the potential benefit of FODMAP strategies to support healthy, recreational athletes who experience GI issues during training. This study therefore aimed to assess whether a short-term LOW_{FODMAP} diet improved exercise-related GI symptoms and the perceived ability to exercise in recreational runners.

Methods: Sixteen healthy volunteers were randomly assigned in a crossover design manner to either a LOW_{FODMAP} ($16.06 \pm 1.79\ g{\cdot}d^{-1}$) or $HIGH_{FODMAP}$ ($38.65 \pm 6.66\ g{\cdot}d^{-1}$) diet for 7 days, with a one week washout period followed by a further 7 days on the alternate diet. Participants rated their gastrointestinal symptoms on an adapted version of the Irritable Bowel Syndrome-Severity Scoring System (IBS-SSS) questionnaire before and at the end of each dietary period. Perceived ability to exercise (frequency, intensity and duration) in relation to each dietary period was also rated using a visual analogue scale. Resting blood samples were collected prior to and on completion of each diet to determine plasma intestinal fatty acid binding protein (I-FABP) as a marker of acute GI injury.

Results: Overall IBS-SSS score significantly reduced in the LOW_{FODMAP} condition from 81.1 ± 16.4 to 31.3 ± 9.2 (arbitrary units; $P = 0.004$). Perceived exercise frequency ($z = 2.309$, $P = 0.02$) and intensity ($z = 2.687$, $P = 0.007$) was significantly improved following a short-term LOW_{FODMAP} approach compared to $HIGH_{FODMAP}$. No significant differences were reported between dietary conditions for plasma I-FABP ($P > 0.05$).

Conclusions: A short-term LOW_{FODMAP} diet under free-living conditions reduced exercise-related GI symptoms and improved the perceived ability to exercise in otherwise healthy, recreational runners. These findings may be explained by a reduction in indigestible carbohydrates available for fermentation in the gut. The therapeutic benefits of LOW_{FODMAP} diets in recreational and trained athletes during sustained training periods warrants further investigation.

Keywords: FODMAP diet, Gastrointestinal symptoms, Nutrition, Recreational athletes

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Introduction

Fermentable oligosaccharides, disaccharides, monosaccharaides and polyols (FODMAPs) are short-chain carbohydrates that are widespread in the diet in foods such as fruits, vegetables, dairy, wheat, grains, legumes, and are commonly added to processed foods to improve palatability. The major types of FODMAPs known to be problematic are fructose, lactose, oligosaccharides and polyols, each of which has a distinct mechanism of action.

Fructose is absorbed in the small intestine by two carrier protein transporters, GLUT2 (in the presence of glucose) and GLUT5, which facilitate fructose diffusion across cell membranes [1, 2]. In some individuals, the limited availability of the GLUT5 transporter results in fructose malabsorption when it is present in excess of glucose [3–7]. Fructose malabsorption is commonly reported both within irritable bowel syndrome (IBS) sufferers (45%) and healthy individuals (34%) [5]. Lactose malabsorption occurs when there is insufficient lactase to break lactose down into its component sugars glucose and galactose [5].

Oligosaccharides are generally poorly absorbed, resulting in the undigested carbohydrates being fermented by gut bacteria [5, 8, 9]. This results in gas production and flatulence in both healthy and hypersensitive individuals which may instigate adverse symptoms [10]. Polyols do not have an associated active transport system and are thought to be absorbed by diffusion [6], which is variable across the intestine and between individuals [11]. If the polyol is too large for diffusion, malabsorption may occur [8], resulting in fermentation or an increased osmotic load leading to fluid retention in the small intestine [12, 13].

Cumulatively, the malabsorption of these short chain carbohydrates as part of a habitual diet may result in increased small intestinal water volume which can affect gut motility [6, 8]. It has previously been established that altered gut motility is associated with symptoms which are analogues to IBS and exercise including nausea, diarrhoea and urge to defecate during exercise [14, 15]. A LOW_{FODMAP} diet has been established as an evidence-based approach to reduce symptoms in approximately 75% of patients diagnosed with IBS [16]. Sixty to 70% of patients report a worsening of IBS symptoms after habitual meals [17], and consequently will eliminate foods that they believe trigger their symptoms [18, 19].

It is possible that hypersensitive individuals are more susceptible to an adverse reaction to a $HIGH_{FODMAP}$ diet a result of the mechanistic changes during exercise [14, 15, 20, 21] which can ultimately impact on training and/or performance. Increasing the intensity and duration of exercise corresponds with slower gastric emptying and potential for structural epithelial damage, tight-junction disruption and transient luminal permeability, as demonstrated through acute elevated levels of plasma intestinal-fatty acid binding protein (I-FABP) [22–24]. It is therefore relevant to consider whether a short-term LOW_{FODMAP} diet impacts on habitual levels of I-FABP, or indeed whether markers of intestinal damage are exacerbated or sustained as a result of a $HIGH_{FODMAP}$ diet.

It has been reported that 30-50% of athletes cite GI issues as one of the most common causes of underperformance in endurance events [15]. This likely explains why athletes may eliminate food groups they believe cause GI distress [25–28], with a gluten free diet becoming one of the most common approaches reported [27]. However, there is little evidence that removal of gluten has any performance benefits for non-coeliac athletes and it has been suggested that gluten may not be a specific trigger of GI symptoms once dietary intake of FODMAPs are reduced [29]. Recent evidence has focused on the use of FODMAP approaches to support recreationally competitive or highly trained athletes. However, there is a paucity of research exploring the potential benefit of FODMAP strategies to support healthy, recreational athletes who experience GI issues during endurance training. Therefore, the purpose of this randomised, crossover trial was to investigate the effect of altering FODMAP intake upon the GI symptoms reported by recreational athletes in free-living conditions during habitual training. It was hypothesised that a short-term LOW_{FODMAP} diet would improve GI symptoms and the perceived ability to exercise.

Materials/methods

Study design

This study employed a randomised, crossover design. The study was conducted in accordance with the Declaration of Helsinki, and ethical approval was granted by the Faculty of Science and Technology Ethics Committee, Anglia Ruskin University (Project Number: FST/FREP/15/567). All participants provided written informed consent prior to study inclusion. All monitoring procedures took place in the Cambridge Centre for Sport and Exercise Sciences, Anglia Ruskin University under controlled conditions.

Participants were required to be healthy, recreationally active runners (training a minimum of 3 days per week with at least 3 months habitual experience, and satisfactorily complete a health screen questionaire) and prepared to comply with study requirements. Ineligible participants were those with a known health condition (including persistent non-exercise related GI issues), current injury, or recent viral infection. Participants were required to only eat foods in conjunction with the lists provided for each 7 day period, and be prepared to weigh food and keep a detailed food log. All participants reported no known or diagnosed gut disorders, were not currently following a LOW_{FODMAP}, ketogenic or calorie restricted diet, were not currently taking antibiotics or probiotics, and had no known blood disorders or allergies.

Participants

An *a priori* power calculation was undertaken based on the primary end point being the difference in IBS–SSS before and after the LOW_{FODMAP} diet. It was estimated that 11 participants were needed per dietary condition to have an 80% power to detect a difference within group of > 1 SD of IBS-SSS score using a paired t-test with a one-sided α of 0.05 based on previous data [6]. Participants ($n = 19$) were recruited through personal contacts with local running clubs. One participant withdrew due to the burden of keeping a weighed food diary and two participants were excluded from the final analysis due to dietary non-compliance. Sixteen participants completed all aspects of the study (10 female, 6 male; age: 44 ± 10 years, height: 1.70 ± 0.78 m, body-mass: 69.2 ± 8.8 kg).

Eating plans and dietary intake

According to previous research which categorized carbohydrates as low or high FODMAP [30–33], two separate food lists were devised for this study containing either high or low FODMAP foods. To protect the integrity of the study, participants were instructed to follow the two diets (with an explanation that the type of carbohydrate was different) with no specific reference to FODMAPs in pre study information. For the purposes of protocol blinding lists were named A and B, although complete blinding was not feasible. In order to mimic dietary choice that athletes make in free-living conditions participants were free to select foods from the list and were individually advised to match their typical dietary and calorie intake and record via a weekly weighed food diary. Participants were provided with example diaries and individually instructed in diary completion, with emphasis on meal breakdown, portion size/weight and weighing procedure. Dietary analyses were undertaken by the same researcher for standardisation using Nutritics Professional Dietary Analysis software (Nutritics Limited, Dublin).

Experimental procedures

Participants attended the laboratory prior to and immediately after each dietary period, and were requested to be rested (no exercise) in the 24-hour period prior to all laboratory measures. For all visits, on arrival, participants rested for 5 minutes prior to fasted blood sample collection, and were then required to complete a symptom questionnaire (see below). Participants were randomised using a pseudo-random number generator (www.randomizer.org) to start on either the low or high FODMAP condition for 7 days based upon previously reported research [34]. All participants undertook a one week washout period between conditions (in a similar manner to previously reported research [10]) and were requested to return to their normal eating patterns during this period before undertaking the opposing dietary condition. Prior to starting, and throughout the study, participants were requested to continue their normal training routine.

Blood sampling and analysis

Upon arrival, a venous whole blood sample was collected from participants by a qualified phlebotomist into dupli cate 4 mL K3EDTA vacutainers (Greiner Bio-One GmbH, Kremsmunster, Austria). Samples were centrifuged for 10 minutes at 3000 rpm, with aliquotted plasma pipetted into sterile, non-pyrogenic, polypropylene cyrovials (Fisherbrand, Fisher Scientific, Loughborough, UK) and immediately frozen at − 80 °C for later assessment of I-FABP using an ELISA kit (Hycult Biotechnology, Uden, the Netherlands; analytical measurement range: 47 to 3000 $pg{\cdot}ml^{-1}$; intra-assay variance: 3.2% at 360 $pg{\cdot}ml^{-1}$, 5.4% at 557 $pg{\cdot}ml^{-1}$ and 6.6% at 809 $pg{\cdot}ml^{-1}$). Reagents were prepared in accordance with the manufactures instructions at room temperature. Duplicate plasma samples were thawed to room temperature (22 °C) and diluted 10-fold using the sample dilution buffer. I-FABP was extracted from the plasma samples by the addition of the following reagents to ELISA kit in the following order: diluted plasma samples; diluted tracer; diluted streptavidin-peroxidase. In between additions the tray was covered with foil, incubated at room temperature (22 °C) for 1 hour before washing. Finally tetramethylbenzidine (TMB) substrate was added to each well and the tray was incubated for 30 minutes at room temperature. The reaction was stopped with the addition of the stop solution and gently mixed. Samples were read on a spectrophotometer at an absorbance of 450 nm (Victir 3 multilabel plate reader, PerkinElmer Inc., Llantrisant, UK) and referenced against a calibration curve (logarithmic scale).

Gastrointestinal symptom monitoring

Prior to, and following each dietary period participants rated individual GI symptoms (i.e. bloating, abdominal pain, flatulence, belching, nausea, diarrhoea, defecation, urge to defecate and constipation) against a standardised 0–100 visual analogue scale (VAS) questionnaire (arbitrary units (au)), with no interference from the research team. Global IBS symptom severity scores (IBS-SSS) were based on accumulated results. Clinically significant change of symptoms was defined as > 20 au on the VAS scale [35]. Participants were also requested to rate their perception of their ability to exercise over the week in which each dietary period occurred. Having recorded their training, participants rated their exercise intensity, duration and frequency based on a category scale (no change 0, improved 1, worsened 2) in comparison to a typical training week. Following this, food diaries were collected and inspected for accuracy, detail and

compliance using a second pass interview approach between the researcher and participant.

Statistical analysis

Statistical analyses were performed using SPSS (IBM, Version 24.0). Normality of data were verified by the Shapiro-Wilks test. Outliers were identified by inspection of box plots > 1.5 IQR in SPSS. A repeated measures ANOVA was used to compare effects of dietary interventions (i.e. nutritional intake, IBS-SSS, I-FABP) with Bonferroni post-hoc assessment where applicable. Where sphericity was violated a Greenhouse Geisser correction was applied. A dependent samples t-test was carried out to assess relative differences between diets where pertinent. Ability to exercise data was analysed using a Wilcoxon signed rank test. An alpha level of $P \leq 0.05$ was considered statistically significant for all tests. Data are presented as mean ± SE.

Results

Dietary intake

No significant differences in mean caloric intake were reported between dietary conditions, or in comparison to habitual intake (F = 2.921, $P = 0.07$, $\eta p^2 = 0.173$; Table 1). When normalised for body-mass, mean habitual caloric intake (34.12 ± 2.48 kcal·kg^{-1}·d^{-1}) was comparable with both LOW_{FODMAP} (29.04 ± 1.88 kcal·kg^{-1}·d^{-1}) and $HIGH_{FODMAP}$ (32.53 ± 2.08 kcal·kg^{-1}·d^{-1}) conditions (F = 3.053, $P = 0.063$, $\eta p^2 = 0.179$). For carbohydrate intake, a significant main effect was observed (F = 7.091, $P = 0.0003$, $\eta p^2 = 0.336$), with participants reporting consuming less total (Table 1) and relative carbohydrate intake during the LOW_{FODMAP} condition compared with the $HIGH_{FODMAP}$ condition (2.79 ± 0.30 g·kg^{-1}·d^{-1} and 3.91 ± 0.36 g·kg^{-1}·d^{-1} respectively, $P = 0.003$).

Total FODMAP intake (including relative to body-mass) was also statistically different between conditions (F = 10.354, $P < 0.0001$, $\eta p^2 = 0.425$), with post-hoc analysis demonstrating the expected reduction with LOW_{FODMAP} (15.75 ± 1.91 g·d^{-1}) compared with both $HIGH_{FODMAP}$ (38.59 ± 6.48 g·d^{-1}, $P = 0.004$) and habitual conditions (28.04 ± 4.33 g·d^{-1}, $P = 0.045$). There were no significant differences reported for dietary fat (habitual: 1.48 ± 0.17 g·kg^{-1}·d^{-1}; LOW_{FODMAP} 1.29 ± 0.15 g·kg^{-1}·d^{-1}; $HIGH_{FODMAP}$ 1.21 ± 0.08 g·kg^{-1}·d^{-1}; F = 1.446, $P = 0.253$) or protein intake (habitual: 1.34 ± 0.10 g·kg^{-1}·d^{-1}; LOW_{FODMAP} 1.35 ± 0.70 g·kg^{-1}·d^{-1}; $HIGH_{FODMAP}$ 1.36 ± 0.08 g·kg^{-1}·d^{-1}; F = 0.142, $P = 0.798$) between experimental conditions or in comparison to habitual intake (total or relative to body-mass).

Gastrointestinal symptom scores (overall)

Mean gastrointestinal symptom scores (IBS-SSS) did not differ between conditions prior to each FODMAP diet ($P > 0.05$), although a wide variance of responses was noted between participants (mean: 66.1 ± 16.3 au; range 0–206 au). A significant diet x time interaction effect was found for IBS-SSS (F = 6.98, $P = 0.02$, $\eta p^2 = 0.32$), with post-hoc analysis indicating a significant reduction in scores from 81.1 ± 16.4 au (pre) to 31.3 ± 9.2 au (post) with LOW_{FODMAP} ($P = 0.004$; Fig. 1). Although a non-significant increase in IBS-SSS was reported with $HIGH_{FODMAP}$ from 51.1 ± 15.7 au (pre) to 104.0 ± 25.0 au (post; $P = 0.08$); overall end-point scores were significantly different between dietary conditions ($P = 0.007$). Expressed as relative change (Fig. 2), a significant difference was also reported between dietary conditions (mean difference = − 102.7 ± 38.9 au; $t = -2.64$, $P = 0.02$) in favour of an improvement in responses following a LOW_{FODMAP} approach. Individual responses indicated that 69% of participants (11/16) reported positive effects of the LOW_{FODMAP} diet, in contrast to 25% (4/16) on the $HIGH_{FODMAP}$ diet.

Table 1 Mean dietary intake under habitual and FODMAP conditions

Variable	Category	Habitual	LOW_{FODMAP}	$HIGH_{FODMAP}$
Total EI	(kcal·d^{-1})	2355.86 ± 197.10	1999.23 ± 138.43	2269.14 ± 162.11
	(kcal·kg^{-1}·d^{-1})	34.12 ± 2.48	29.04 ± 1.88	32.53 ± 2.08
Carbohydrates	(g·d^{-1})	245.77 ± 19.05	193.53 ± 21.56*	272.28 ± 26.23
	(g·kg^{-1}·d^{-1})	3.55 ± 0.22	2.79 ± 0.30*	3.91 ± 0.36
FODMAPs	(g·d^{-1})	28.04 ± 4.33	15.75 ± 1.91*, a	38.59 ± 6.48
	(g·kg^{-1}·d^{-1})	0.42 ± 0.07	0.23 ± 0.03*, a	0.56 ± 0.09
Protein	(g·d^{-1})	92.13 ± 7.82	94.34 ± 5.81	94.64 ± 6.54
	(g·kg^{-1}·d^{-1})	1.34 ± 0.10	1.35 ± 0.07	1.36 ± 0.08
Fat	(g·d^{-1})	101.95 ± 12.74	88.48 ± 9.88	83.92 ± 5.82
	(g·kg^{-1}·d^{-1})	1.48 ± 0.17	1.29 ± 0.15	1.21 ± 0.08

Table 1 outlines mean habitual dietary intake and between dietary conditions with data expressed in total amounts per day. *EI* = energy intake. * denotes significant difference between LOW_{FODMAP} and $HIGH_{FODMAP}$ conditions only ($P < 0.004$). [a] denotes significant difference to habitual diet ($P < 0.045$)

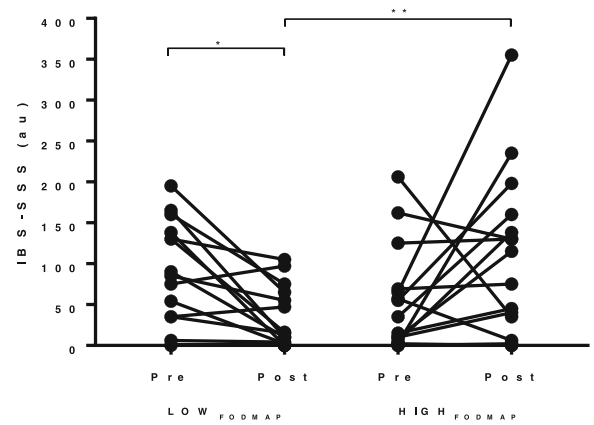

Fig. 1 Participant GI symptom scores following each dietary intervention. Displays individual participant accumulated IBS-symptom severity scores following each FODMAP condition. Au = arbitrary units. * denotes significant difference pre-post within group ($P = 0.004$); ** denotes significant difference between dietary conditions (post; $P = 0.007$)

Gastrointestinal symptom scores (individual)

Table 2 demonstrates mean responses to individual GI symptoms across both dietary conditions. A significant diet x time interaction effect was found for pain ($F = 6.861$, $P = 0.019$, $\eta p^2 = 0.314$) with post hoc analyses indicating that end-point scores were significantly different between dietary conditions (4.13 ± 2.52 au for LOW_{FODMAP} and 22.50 ± 6.35 au for $HIGH_{FODMAP}$ respectively, $P = 0.003$), which coincided with significant within-group changes for both LOW_{FODMAP} ($P = 0.031$) and $HIGH_{FODMAP}$ ($P = 0.028$). A significant main effect (time) was reported for flatulence ($F = 4.428$, $P = 0.05$, $\eta p^2 = 0.228$), as well as a main effect (diet) for belching ($F = 5.686$, $P = 0.03$, $\eta p^2 = 0.275$), although post-hoc analyses were not significant. A significant main effect (diet) was reported for bloating ($F = 6.186$, $P = 0.025$, $\eta p^2 = 0.292$), with post-hoc analyses indicating that end-point scores were significantly different between dietary conditions (1.25 ± 0.72 au for LOW_{FODMAP} and 12.69 ± 4.53au for $HIGH_{FODMAP}$ respectively, $P = 0.021$). All symptoms except constipation and defecation recorded a decrease in score on the LOW_{FODMAP}, whilst all symptoms except flatulence recorded an increase in score on the $HIGH_{FODMAP}$ diet, however no other significant findings were reported.

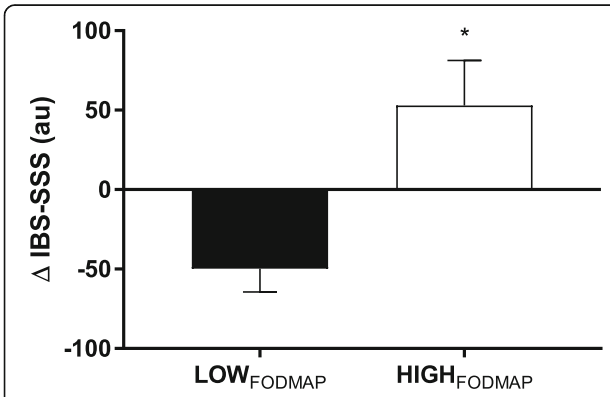

Fig. 2 Relative changes in mean GI symptom responses following each dietary condition. The figure demonstrates the mean delta change in GI responses following each FODMAP condition. Au = arbitrary units. * denotes significant difference between conditions ($P = 0.02$)

FODMAP intake and self-reported ability to exercise

There was a statistically significant median difference in the perceived exercise frequency ($z = 2.309$, $P = 0.02$) and intensity ($z = 2.687$, $P = 0.007$) between a LOW_{FODMAP} and $HIGH_{FODMAP}$ diet. No significant median difference was reported in perceived exercise duration on a LOW_{FODMAP} and $HIGH_{FODMAP}$ diet ($z = 1.414$, $P = 0.157$). Participants were more likely to report that the ability to exercise improved on a LOW_{FODMAP} diet (frequency (4/16), intensity (6/16)), and deteriorated on a $HIGH_{FODMAP}$ diet (frequency (4/16), intensity (9/16)).

FODMAP intake and intestinal fatty acid binding protein (I-FABP) levels

The effect of both FODMAP diets on I-FABP levels under resting conditions is shown in Fig. 3. A non-significant increase from 206.93 ± 7.27 pg·ml^{-1} to 219.46 ± 10.42 pg·ml^{-1} was noted for LOW_{FODMAP} remaining within expected limits. I-FABP for $HIGH_{FODMAP}$ remained comparable across the intervention (218.21 ± 10.93 pg·ml^{-1} to 222.60 ± 13.08 pg·ml^{-1}; $P > 0.05$). No significant interaction effects were reported ($P > 0.05$) between dietary conditions.

Discussion

This study aimed to investigate the perceived effect of acute FODMAP intake on GI symptom severity and ability to exercise in recreational athletes under free-living conditions. Whilst the clinical effectiveness of a LOW_{FODMAP} diet in treating IBS is established in the literature [16, 28], research into the potential therapeutic effects in otherwise healthy, recreational athletes is limited. The main findings from the current study revealed that short-term LOW_{FODMAP} intake significantly improved exercise-related GI symptoms in 69% of participants. These results support recent observations [36] demonstrating reductions in daily GI symptoms in trained athletes on a short-term (6-day) LOW_{FODMAP} diet, as well as reduced GI symptom severity in case studies of a male [37] and female [38] runner. Consistency between these findings infers that both recreational and more trained athletes may benefit from self-prescribed LOW_{FODMAP} approaches in the short-term, providing there is compliance with food choices. This may have implications for

Table 2 Mean responses to individual GI symptoms across both dietary conditions

	LOW_{FODMAP}		$HIGH_{FODMAP}$		
Symptom	PRE	POST	PRE	POST	Interaction
Nausea	4.75 ± 2.86	0.88 ± 0.45	1.56 ± 0.63	4.94 ± 2.22	0.096
Pain	19.75 ± 6.75	4.13 ± 2.52 [a]	7.63 ± 3.15	22.50 ± 6.35 [a,b]	0.019*
Belching	3.38 ± 1.92	2.25 ± 1.45	3.56 ± 1.91	7.50 ± 2.99	0.218
Flatulence	14.75 ± 3.66	8.50 ± 2.84	17.38 ± 5.29	13.81 ± 3.57	0.705
Constipation	3.75 ± 2.72	4.00 ± 2.82	0.56 ± 0.34	4.19 ± 2.71	0.369
Diarrhoea	12.19 ± 5.70	3.06 ± 1.83	3.75 ± 3.75	13.13 ± 5.72	0.149
Defecation	2.50 ± 1.88	2.88 ± 2.23	0.37 ± 0.32	8.75 ± 5.21	0.247
Urge to defecate	12.19 ± 4.92	5.13 ± 2.67	7.69 ± 4.96	17.06 ± 6.70	0.155
Bloating	7.88 ± 4.15	1.25 ± 0.72	8.94 ± 4.96	12.69 ± 4.53[b]	0.236

Table 2 displays mean data for individual GI symptoms (arbitrary units) across both dietary interventions. * denotes significant interaction effect ($P < 0.02$). [a] denotes significant change within-group ($P < 0.03$). [b] denotes significant post-diet difference in comparison to LOW_{FODMAP} ($P < 0.02$)

longer term FODMAP strategies during sustained training periods, which may provide adjunct nutritional support in maintaining training volume and/or intensity [20] particularly in symptomatic individuals who suffer from GI distress with exercise.

Whilst a LOW_{FODMAP} approach appeared to result in improved scores for most individual symptoms, only responses to perceived pain and bloating were significantly different between conditions following the dietary interventions. This suggests that whilst an improvement in overall GI symptom severity may reflect accumulated reductions in individual symptom responses, the effects of a short-term LOW_{FODMAP} diet may in fact be specific. The reported improvement in perceived pain, in conjunction with reduced experiences of bloating whilst on a LOW_{FODMAP} diet is likely explained by a reduction in intestinal water volume and gas production [6, 10, 39]. Strategies to reduce or minimise such GI symptoms may be important for recreational athletes, especially considering the reported negative impact on exercise training and/ or performance [15, 40, 41]. However, based on the wide inter-individual responses observed across conditions, such findings should be interpreted with caution.

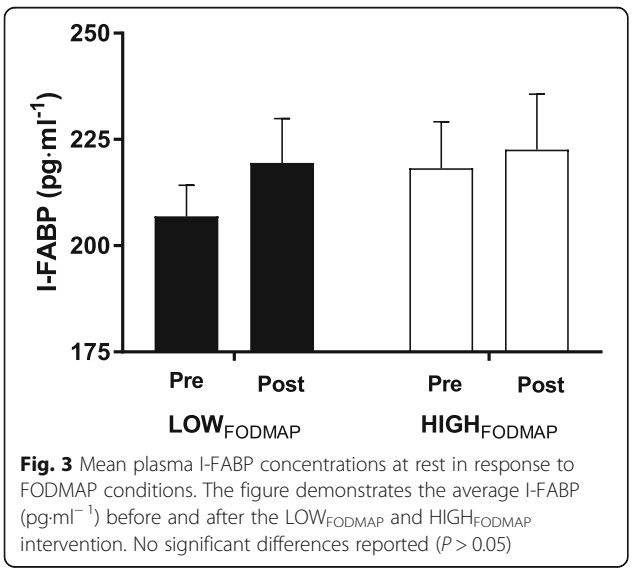

Fig. 3 Mean plasma I-FABP concentrations at rest in response to FODMAP conditions. The figure demonstrates the average I-FABP ($pg \cdot ml^{-1}$) before and after the LOW_{FODMAP} and $HIGH_{FODMAP}$ intervention. No significant differences reported ($P > 0.05$)

An interesting observation from the current study was the improved perception of exercise frequency and intensity from participants whilst undertaking the LOW_{FODMAP} approach. Although this only reflected perceived changes in the short-term (7 days), this may have implications for sustained approaches where training routines may be disrupted (including volume and intensity) due to GI-related issues. Participants were requested to maintain their typical training routine throughout the study to assess whether perceived changes (in frequency, training duration or intensity) were related to the dietary intervention. Whilst a significant effect was observed for improved perception of exercise frequency and intensity following a LOW_{FODMAP} approach, this only occurred in 25 and 38% of the participants respectively. Only one other study [36] appears to have attempted to standardise training sessions (albeit 2 sessions in a 6-day period) whilst participants undertook an acute LOW_{FODMAP} or $HIGH_{FODMAP}$ diet. In this study, daily GI symptoms for flatulence, urge to defecate and diarrhoea were reportedly improved in the LOW_{FODMAP} condition [36]. However, assessment of participants' perception of training session ability in relation to the dietary approach was not considered. Further research to establish training related benefits of a LOW_{FODMAP} strategy, particularly with symptomatic individuals, is therefore warranted.

Moderate to high-intensity exercise impacts on gastric emptying, GI transit and intestinal absorption due to GI hypoperfusion and ischemia [15, 22]. Provocation of luminal tight junction proteins (e.g. caludin and occludin) through increased expression of phosphorylation enzymes, reactive oxygen species (ROS) activity and cytokine mediators may lead to acute GI permeability

[22, 23, 42] and paracellular transport. Although transient, acute GI disruption may exacerbate nutrient malabsorption, as well as provoke delayed systemic immune responses. Increased residual $HIGH_{FODMAP}$ GI content as a result of malabsorption [43], along with increased delivery of fluid to the colon and reduced GI motility could synergistically impact on perceived severity of symptoms, including acute or transient pain. This may limit the intensity of exercise training, particularly in symptomatic or hypersensitive individuals. The reduction in pain observed in this study, along with improved perception of flatulence and bloating symptoms within-group, indicates that lowering FODMAPs in the diet may support exercise training. Mechanistically, a reduction in fluid re-uptake across the GI epithelia, leading to less fluid and gas build-up pre- or during exercise in response to daily or more habitual LOW_{FODMAP} approaches may assist with sustained exercise tolerance.

In connection with perceived symptom changes, this study also investigated whether a short-term FODMAP approach impacted on basal GI damage via assessment of I-FABP. Whilst it was hypothesised that a $HIGH_{FODMAP}$ diet may lead to an elevated residual level of I-FABP following the short-term intervention, no significant differences were observed within or between conditions. Therefore, even though a $HIGH_{FODMAP}$ approach may have resulted in increased perception of symptom severity, disruption of the epithelial barrier in response to dietary modifications was not evident. Previous research has demonstrated that splanchnic hypoperfusion in response to acute, moderate exercise resulted in elevated I-FABP from 309 ± 46 pg·ml^{-1} to 615 ± 118 pg·ml^{-1} in healthy, male volunteers [22], which rapidly returned to baseline concentrations within minutes of recovery. I-FABP is a sensitive marker of small intestinal cell damage. However, rapid changes as observed in the previous study [22] indicate that GI damage is highly transient, and possibly only in response to exercise-based hypoperfusion, which may explain the lack of significant residual findings under resting conditions in the current study. Assessment of I-FABP and/or GI permeability (e.g. urinary lactulose: rhamanose evaluation) in response to daily bouts of exercise in conjunction with a FODMAP approach may, however, provide mechanistic understanding of the potential benefits of a LOW_{FODMAP} diet.

A limitation to the current study observed when implementing a LOW_{FODMAP} diet in free-living conditions was that participants tended to consume fewer calories compared to both habitual and $HIGH_{FODMAP}$ intakes, albeit non-significant. Taking into consideration methodological constraints in maintaining a weighed food diary, this observation was supported by a significant reduction in carbohydrate intake to achieve LOW_{FODMAP} adherence. This finding is consistent with a case study of a female athlete competing in a Multistage Ultramarathon [38], which reported that whilst following a LOW_{FODMAP} approach total daily energy intake did not meet estimated energy requirements. Upon further investigation suboptimal carbohydrate intake rather than protein and fat was observed.

Similar findings have been reported elsewhere [44], in which 29% of participants reported acute weight loss whilst on a LOW_{FODMAP} approach in free-living conditions. Many carbohydrate-rich foods typically consumed by active individuals (e.g. pasta, cereals, bread, energy drinks) are $HIGH_{FODMAP}$, whereas alternative food sources (e.g. rice, corn) may be less palatable or more difficult to substitute. Indeed, in the previous study [44], participants cited that LOW_{FODMAP} approaches were either too complicated, expensive, or did not enjoy the overall taste as reasons for not sustaining the diet. The potentially restrictive or limiting nature of food choices on a LOW_{FODMAP} diet could therefore outweigh GI symptom benefits in the longer term due to weight loss, lethargy, fatigue, perceived effort, cost and/or enjoyment. Furthermore, a sustained energy/carbohydrate reduction in the longer term could also impact on training maintenance and recovery adaptations, and lead to unintended reduced nutrient availability.

However, the finding that acute dietary FODMAP manipulation positively impacted on overall GI symptom severity has pertinent implications for active individuals, particularly those more symptomatic or hypersensitive. Future research should consider whether there is a threshold of symptom severity in the context of exercise above which individuals may benefit from a LOW_{FODMAP} nutritional approach. There is also the need to establish the minimum intervention length required to alleviate GI symptoms in both recreational and trained athletes; as well as how long interventions can be sustained or indeed whether a FODMAP approach can impact on prolonged training periods. This is especially important considering the finding that carbohydrate intake was reduced on the LOW_{FODMAP} diet in free-living conditions, and the known importance of carbohydrates in fuelling regular exercise. Finally, whilst a LOW_{FODMAP} diet is known to significantly affect the gut microflora composition [45–47], the consequences of prolonged LOW_{FODMAP} intake on other types of physical activity, particularly those of a high-intensity or intermittent nature, has yet to be determined.

Conclusion

In conclusion, this study provides evidence that recreational athletes implementing a short-term LOW_{FODMAP} diet under free-living conditions may experience benefits in exercise-related GI symptoms and perceived

improvements in exercise intensity and frequency. However, caution is warranted to minimise unnecessary reductions in total caloric and/or carbohydrate intake that may impact on nutritional quality. Further studies are warranted to investigate the impact of a LOW_{FODMAP} diet on sustained training strategies in healthy, recreationally active individuals and trained athletes.

Abbreviations

ANOVA: analysis of variance; ELISA: Enzyme-linked immunosorbent assay; FODMAP: Fermentable oligosaccharide, disaccharide, monosaccharide and polyol diet; GI: Gastrointestinal; IBS: Irritable bowel syndrome; IBS-SSS: Irritable bowel syndrome-symptom severity score; I-FABP: Intestinal fatty acid binding protein; ROS: Reactive oxygen species

Acknowledgements

The authors wish to acknowledge data collection support from Craig Suckling. We thank BRJ Run and Triathlon Club (Huntingdon) for assistance in recruiting participants.

Funding

There was no external funding for this study. However, local funding support was provided by the Open Access Publishing Fund, Anglia Ruskin University.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

All authors were involved in the study. JR and MW conceived and designed the study; MW was centrally involved with data collection; data were analysed by MW and JR with statistical support from LS; MW and JR constructed the manuscript. All authors reviewed the manuscript and approved the final version prior to submission.

Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Faculty of Science and Technology Ethics Committee, Anglia Ruskin University (FST/FREP/15/567).Written informed consent was obtained from all individual participants included in the study.

Consent for publication

As part of the written informed consent procedure, all participants were duly made aware (as part of both the study briefing and information sheet) that the study results may be published. As such, consent for publication was included as part of this process.

Competing interests

The authors declare that they have no competing interests.

Publisher's Note

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Received: 8 October 2018 Accepted: 3 January 2019
Published online: 15 January 2019

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Atención Primaria

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DOCUMENTO DE CONSENSO

Guía de práctica clínica: síndrome del intestino irritable con estreñimiento y estreñimiento funcional en adultos: concepto, diagnóstico y continuidad asistencial. (Parte 1 de 2)☆

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PALABRAS CLAVE
Síndrome del intestino irritable;
Estreñimiento funcional;
Molestia abdominal;
Adultos;

Resumen En esta Guía de práctica clínica analizamos el manejo diagnóstico y terapéutico de pacientes adultos con estreñimiento y molestias abdominales, bajo el espectro del síndrome del intestino irritable y el estreñimiento funcional. Tienen una importante repercusión personal, sanitaria y social, afectando a la calidad de vida de los pacientes que las padecen. En el síndrome del intestino irritable con predomino del estreñimiento, este es la alteración deposicional predominante junto con dolor abdominal recurrente, hinchazón y distensión abdominal frecuente. El estreñimiento se caracteriza por la dificultad o la escasa frecuencia en las deposiciones, acompañado por esfuerzo excesivo durante la defecación o sensación de evacuación

☆ Este trabajo se publica conjuntamente por la SEPD, la semFYC, la SEMERGEN y la SEMG. La publicación original íntegra se realizó por la SEPD en (1): Rev Esp Enferm Dig 2016, 108(6): 332-363. SemFYC, SEMERGEN y SEMG publican el trabajo en dos partes, para la accesibilidad de sus respectivos socios, siendo esta la primera.
Nota metodológica. Esta GPC ha sido desarrollada entre enero de 2015 y diciembre de 2015 por un Grupo de Trabajo formado por expertos seleccionados por la SEPD, la semFYC, la SEMERGEN y la SEMG. Entre diciembre de 2015 y abril de 2016 ha sido sometida a revisión, con la última adaptación a Roma IV en mayo de 2016 (1). Para un detalle del proceso metodológico de trabajo mediante el cual se ha elaborado esta GPC ver: http://www.sepd.es/file/GPC_SII_E_EF_Metodologia.pdf

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http://dx.doi.org/10.1016/j.aprim.2016.11.003

Atención Primaria;
Enfermedades digestivas;
Guía de práctica clínica;
Roma IV

incompleta. La mayoría no tienen una causa orgánica subyacente, considerándose un trastorno funcional intestinal. Poseen muchas similitudes clínicas y fisiopatológicas, con respuesta similar del estreñimiento a fármacos comunes. La diferencia fundamental es la presencia o ausencia de dolor, pero no de un modo evaluable como «todo o nada». La gravedad depende tantro de la intensidad de los síntomas intestinales como de otros factores: asociación de síntomas gastrointestinales y extraintestinales, grado de afectación, formas de percepción y comportamiento. Los criterios de Roma diagnostican los trastornos funcionales intestinales. Esta Guía está adaptada a los criterios de Roma IV (mayo de 2016) y analiza, en esta primera parte, los criterios de alarma, las pruebas diagnósticas y los criterios de derivación entre Atención Primaria y Aparato Digestivo. En una segunda parte, se revisarán las alternativas terapéuticas disponibles (ejercicio, dieta, tratamientos farmacológicos, neuroestimulación de raíces sacras o cirugía), efectuando recomendaciones prácticas para cada una de ellas.

KEYWORDS
Irritable bowel syndrome;
Functional constipation;
Abdominal discomfort;
Adults;
Primary Care;
Digestive Diseases;
Clinical practice guide;
Rome IV

Clinical practice guidelines: Irritable bowel syndrome with constipation and functional constipation in adults: Concept, diagnosis, and healthcare continuity. (Part 1 of 2)

Abstract In this Clinical practice guide, an analysis is made of the diagnosis and treatment of adult patients with constipation and abdominal discomfort, under the spectrum of irritable bowel syndrome and functional constipation. These have an important personal, health and social impact, affecting the quality of life of these patients. In irritable bowel syndrome with a predominance of constipation, this is the predominant change in bowel movements, with recurrent abdominal pain, bloating and frequent abdominal distension. Constipation is characterised by infrequent or difficulty in bowel movements, associated with excessive straining during bowel movement or sensation of incomplete evacuation. There is often no underling cause, with an intestinal functional disorder being considered. They have many clinical and pathophysiological similarities, with a similar response of the constipation to common drugs. The fundamental difference is the presence or absence of pain, but not in a way evaluable way; ''all or nothing''. The severity depends on the intensity of bowel symptoms and other factors, a combination of gastrointestinal and extra-intestinal symptoms, level of involvement, forms of perception, and behaviour. The Rome criteria diagnose functional bowel disorders. This guide is adapted to the Rome criteria IV (May 2016) and in this first part an analysis is made of the alarm criteria, diagnostic tests, and the criteria for referral between Primary Care and Digestive Disease specialists. In the second part, a review will be made of the therapeutic alternatives available (exercise, diet, drug therapies, neurostimulation of sacral roots, or surgery), making practical recommendations for each one of them.

Aspectos conceptuales, impacto y fisiopatología

¿Por qué abordar el síndrome del intestino irritable con estreñimiento y el estreñimiento funcional en el adulto conjuntamente?

El síndrome del intestino irritable (SII) y el estreñimiento funcional (EF) son dos trastornos funcionales intestinales (TFI)[1–3]. Por tanto, ambos comparten que su causa no se explica por las alteraciones morfológicas, metabólicas o neurológicas demostrables por las técnicas diagnósticas habituales. El SII se divide, de acuerdo al tipo de alteración del hábito deposicional predominante, en SII con estreñimiento (SII-E) y SII con diarrea (SII-D); cuando se combinan ambos trastornos, estreñimiento y diarrea, se habla de SII de tipo mixto y SII de tipo indeterminado cuando el patrón de las deposiciones es intermedio y no puede clasificarse como diarrea ni estreñimiento[2,3].

Aunque desde un punto de vista conceptual el SII-E y el EF son dos TFI diferentes, en la práctica pueden ser muy parecidos e incluso indistinguibles[4–6]. En los dos el estreñimiento es un síntoma primordial, como también lo es la hinchazón/distensión del abdomen. La presencia de dolor abdominal más de una vez a la semana, y la relación temporal del dolor con la defecación, es lo que teóricamente diferencia al SII-E del EF[2]. Sin embargo, puede haber pacientes con EF y un cierto grado de dolor y la relación temporal no siempre es fácil de establecer[4]. En realidad, el SII-E y el EF forman un espectro en el que en un extremo estarían los pacientes con dolor abdominal muy importante

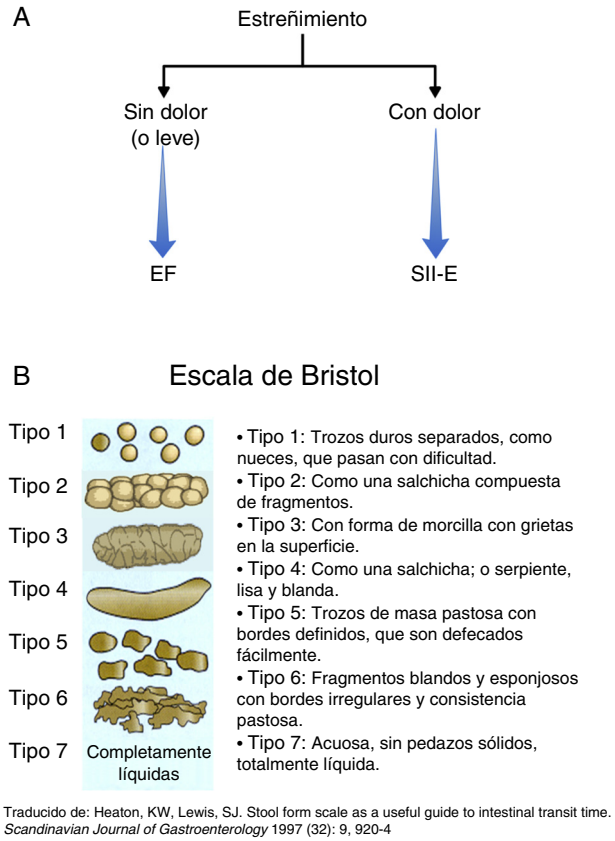

Figura 1 Tipos de estreñimiento.
Fuente: Lewis y Heaton[15].

junto con estreñimiento, y en el otro los pacientes con estreñimiento y ausencia absoluta de dolor; en la práctica, la mayoría de los casos están en un lugar intermedio. De hecho, pudiera ser más lógico clasificar este tipo de TFI de la siguiente manera: estreñimiento con dolor (similar al SII-E) y estreñimiento sin dolor (similar al EF) (fig. 1A).

Además de estas similitudes conceptuales y clínicas, el SII-E y el EF tienen diversos mecanismos patogénicos comunes y en ambos se han demostrado respuestas beneficiosas a los mismos fármacos[7–12].

Todos los aspectos anteriores nos han movido a realizar una Guía de práctica clínica (GPC) en la que se abordan de manera conjunta el SII-E y el EF. Sin duda, entre ellos hay más semejanzas que diferencias.

¿Qué es el síndrome del intestino irritable?

El SII se caracteriza por la presencia de dolor abdominal recurrente asociado a alteraciones del ritmo deposicional, ya sea en forma de estreñimiento, de diarrea, o de ambas; la hinchazón y la distensión abdominal son muy frecuentes en el SII[2,3]. De acuerdo a los criterios de Roma IV el SII se diagnostica por la presencia de dolor abdominal recurrente que debe estar presente al menos un día a la semana, con dos o más de las siguientes características: 1. se asocia a la defecación; 2. está relacionado con un cambio en la frecuencia de las deposiciones; 3. está relacionado con un cambio en la consistencia de las deposiciones. En cuanto a los requerimientos de duración de las molestias hay que tener en cuenta que los criterios deben cumplirse durante los últimos tres meses y los síntomas haber comenzado un mínimo de seis meses antes del diagnóstico[2,3].

El solapamiento del SII con otros TFI (como el EF o la diarrea funcional), otros trastornos funcionales digestivos no intestinales (como la dispepsia funcional o la pirosis funcional) o extradigestivos (como la fibromialgia o la cistitis intersticial) es muy frecuente[13,14].

El diagnóstico debe fundamentarse en los síntomas característicos que se han sistematizado en los criterios de Roma IV (tablas 1 y 2, fig. 2), aunque ello no exime de realizar las exploraciones pertinentes para establecer el diagnóstico

Tabla 1 Criterios* de Roma IV para el diagnóstico de síndrome del intestino irritable con predominio estreñimiento

Dolor abdominal recurrente, como media, al menos un día a la semana en los últimos tres meses relacionado con dos o más de los siguientes criterios: Se relaciona con la defecación Se asocia a un cambio en la frecuencia de las deposiciones Se asocia a un cambio en la forma (apariencia) de las deposiciones En el *SII con predominio de estreñimiento* más de un 25% de las deposiciones con heces tipo 1 o 2 de Bristol y menos del 25% con heces tipo 6 o 7 de Bristol (el paciente refiere que sus deposiciones alteradas son habitualmente como estreñimiento). El hábito intestinal predominante se basa en la forma de las heces en los días con al menos una deposición alterada. El predominio de estreñimiento solo puede ser establecido con seguridad cuando el paciente es evaluado sin tomar medicación para tratar alteraciones del hábito intestinal.

Fuente: Lacy et al.[3].
* Los criterios deben cumplirse al menos durante los últimos tres meses y los síntomas deben haberse iniciado como mínimo 6 meses antes del diagnóstico.

Tabla 2 Criterios* de Roma IV para el diagnóstico de estreñimiento funcional

1. Presencia de dos o más de los siguientes criterios:
   - Esfuerzo excesivo al menos en el 25% de las deposiciones
   - Heces duras al menos en el 25% de las deposiciones (tipo 1-2 de Bristol)
   - Sensación de evacuación incompleta al menos en el 25% de las deposiciones
   - Sensación de obstrucción o bloqueo anorrectal al menos en el 25% de las deposiciones
   - Maniobras manuales para facilitar la defecación al menos en el 25% de las deposiciones
   - Menos de tres deposiciones espontáneas completas a la semana
2. La presencia de heces líquidas es rara sin el uso de laxantes
3. No deben existir criterios suficientes para el diagnóstico de SII

Fuente: Lacy et al.[3].
* Los criterios deben cumplirse al menos durante los últimos tres meses y los síntomas deben haberse iniciado como mínimo seis meses antes del diagnóstico.

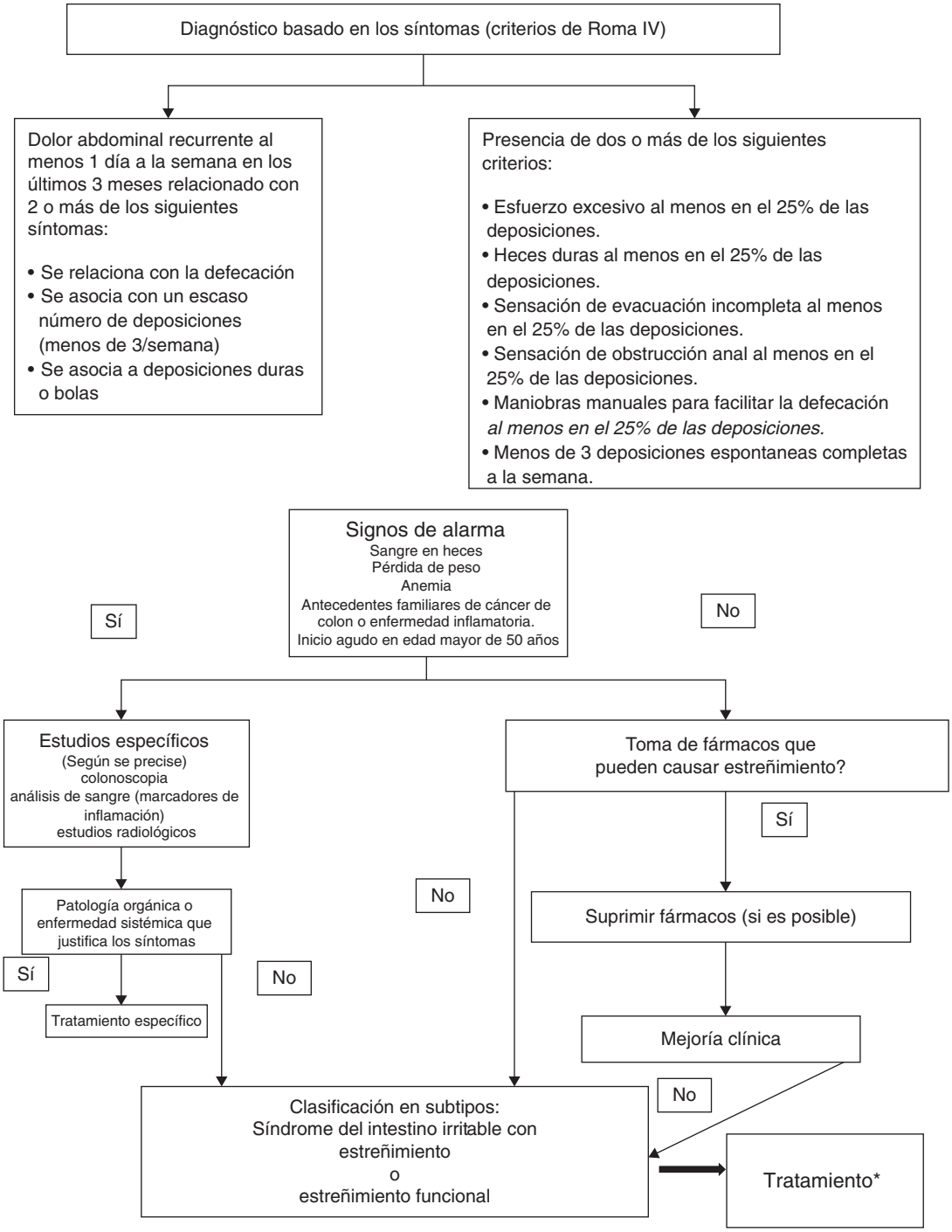

Figura 2 Algoritmo diagnóstico del síndrome del intestino irritable y del estreñimiento funcional.
* ver figura 1 de la segunda parte. febrero 2017.

diferencial con algunas patologías orgánicas que pueden manifestarse de forma similar.

¿Qué es el síndrome del intestino irritable con estreñimiento?

El SII-E es el subtipo de SII en el que el estreñimiento es la alteración deposicional predominante. Las características de las heces permiten clasificar los subtipos del SII utilizando la escala de Bristol (fig. 1B)[15]. Según el porcentaje de uno u otro tipo de heces, en los días en que estas son anormales, se establecen como SII-E, SII-D o síndrome de intestino irritable mixto. En el caso de SII-E se precisa que en más de un 25% de las deposiciones las heces sean de tipo 1 o 2 y que en menos de un 25% de las deposiciones las heces sean de tipo 6 o 7[2,3].

¿Qué es el estreñimiento funcional?

El estreñimiento se caracteriza por la dificultad o la escasa frecuencia en relación con las deposiciones, a menudo acompañado por esfuerzo excesivo durante la defecación o sensación de evacuación incompleta[2,3]. En la mayoría de los casos no tiene una causa orgánica subyacente, siendo considerado un TFI. De acuerdo a los criterios de Roma IV el EF se define como la presencia durante los últimos 3 meses de dos o más de los siguientes: 1) esfuerzo defecatorio (≥ 25% deposiciones); 2) deposiciones duras o caprinas (≥25% deposiciones); 3) sensación de evacuación incompleta (≥25% deposiciones); 4) obstrucción defecatoria (≥ 25% deposiciones); 5) maniobras manuales para la defecación (≥ 25% deposiciones); y 6) menos de 3 deposiciones espontáneas completas/semana. Los síntomas deben haber comenzado un mínimo de 6 meses antes del diagnóstico, no existir diarrea si no es tras la toma de laxantes, y no cumplirse criterios de SII[2].

La Asociación Americana de Gastroenterología prefiere realizar una definición más sencilla, aunque en realidad es muy similar: «defecaciones insatisfactorias caracterizadas por deposiciones infrecuentes, heces difíciles de evacuar, o ambos, durante al menos 3 meses. La dificultad en evacuar las heces incluye el esfuerzo, la sensación de evacuación incompleta, las heces duras, el tiempo prolongado para defecar y la necesidad de maniobras manuales»[16].

Sin embargo, estas definiciones han sido establecidas por consensos médicos y opiniones de expertos, siendo importante conocer cuál es la opinión de los propios pacientes sobre el estreñimiento. Así, en un estudio poblacional realizado en EE. UU., de un total de 557 sujetos con estreñimiento el porcentaje de síntomas que aquejaban eran los siguientes: 79% esfuerzo excesivo, 74% gases, 71% heces duras, 62% molestia abdominal, 57% deposiciones poco frecuentes, 57% distensión abdominal y 54% sensación de evacuación incompleta[17].

¿En qué se parecen y en qué se diferencian el síndrome del intestino irritable con estreñimiento y el estreñimiento funcional?

Tal y como se ha comentado anteriormente son muchas las similitudes clínicas entre el SII-E y el EF: más frecuentes en personas de características similares (mujeres de mediana edad), obviamente la presencia de estreñimiento (pero también de distensión hinchazón abdominal), y respuesta similar del estreñimiento a fármacos comunes. Además, es importante hacer constar que el estreñimiento es de características semejantes en ambos TFI[4]. La diferencia fundamental estriba en la presencia o ausencia de dolor, pero nuevamente se debe señalar que este es un aspecto discutible, y no evaluable como «todo o nada».

En lo que se refiere a la fisiopatología, las causas del estreñimiento también son comunes: alteraciones de la motilidad colónica, dificultad expulsiva, ausencia de compresión abdominal suficiente, y combinación de las anteriores. Recordar, no obstante, que en un considerable número de casos (en especial con SII-E) puede no detectarse ninguna de las causas anteriores.

La diferencia fisiopatológica fundamental pudiera ser la distinta sensibilidad visceral en uno y otro caso: más frecuente la hipersensibilidad colónica en el SII y más frecuente la hiposensibilidad rectal en el EF[18–20].

¿Cuál es la importancia clínica, social y económica del síndrome del intestino irritable con estreñimiento y del estreñimiento funcional?

Algunos médicos consideran al SII-E y el EF como unas patologías banales pero la realidad es que su repercusión personal, sanitaria y social es muy importante. La calidad de vida relacionada con la salud (CVRS) de los pacientes con SII está notablemente alterada como reflejan varias revisiones al respecto[21,22]. A su vez, los costes asociados al SII son importantes. Baste citar que solo en los EE. UU. consultan anualmente por este problema 3,5 millones de personas, lo que supone un gasto anual de 20.000 millones de dólares[23]. Datos obtenidos en Europa, y específicamente en España, también demuestran el incremento de los costes directos e indirectos en los pacientes con SII-E[24].

En lo que se refiere a la repercusión del EF en las actividades cotidianas de los pacientes que lo padecen, el 69% considera que afecta a su rendimiento escolar o laboral[17], siendo una causa relevante de absentismo en los casos graves (media de pérdida de días de actividad de 2,4/mes) y de disminución de la productividad[17]. Otros estudios han confirmado las repercusiones sociales al comparar datos de sujetos con EF y población general[25]. Todo ello condiciona que el gasto sanitario, directo e indirecto, del EF sea enorme. En EE. UU. conlleva aproximadamente 2,5 millones de visitas cada año y 92.000 hospitalizaciones anuales, con un coste en exploraciones de casi 7.000 millones de dólares[25,26].

En lo que respecta a la CVRS en el EF sirvan como resumen los resultados de una revisión sistemática publicada en el año 2010. Se identificaron 10 estudios utilizando diferentes cuestionarios de salud genéricos:

Siete que utilizaban el *Short Form 36*, dos el *Psychological General Well Being Index* y uno el SF-12[27]. Se comprobó que, utilizando el *Short Form 36*, prácticamente todos los dominios estaban alterados en los pacientes con EF al compararlos con los controles sanos; como era de esperar las diferencias eran mayores en los pacientes atendidos en el ámbito hospitalario que en el ambulatorio.

Cuando se compara la CVRS de los pacientes con estreñimiento con otras patologías frecuentes el resultado es sorprendente[27]. El impacto en los aspectos físicos de los pacientes con EF que precisan atención especializada es mayor, por ejemplo, que el de la colitis ulcerosa, estable o inestable, la enfermedad de Crohn estable, o que el de enfermedades no digestivas como las alergias crónicas, o el dolor de espalda.

¿Cómo establecer la gravedad del síndrome del intestino irritable con estreñimiento y del estreñimiento funcional?

La gravedad de los TFI, incluidos el SII y el EF, depende no solo de la intensidad de los síntomas intestinales

sino también de otros factores biopsicosociales: asociación de síntomas gastrointestinales y extraintestinales, grado de afectación, y formas de percepción y comportamiento. De tal forma, tanto los factores fisiológicos viscerales como los centrales influyen en la gravedad del SII. A su vez, la gravedad, afecta directamente a la calidad de vida, y debe tenerse en cuenta a la hora de tomar decisiones diagnósticas y terapéuticas[28,29].

La gravedad del SII, y de otros TFI, se establece por lo general de dos formas: 1) utilizando una escala individual de síntomas (ej.: leve, moderado, grave, muy grave); o 2) mediante la combinación de múltiples síntomas o actitudes (ej.: dolor abdominal junto con la consistencia y frecuencia de las deposiciones, urgencia defecatoria, impacto en la calidad de vida, utilización de recursos sanitarios, y grado de discapacidad).

El cuestionario más ampliamente utilizado para valorar la gravedad del SII es el llamado «*Irritable Bowel Syndrome Severity Scoring System* »[30]. En él se analizan la intensidad de 5 ítems diferentes durante un periodo de 10 días: dolor abdominal, distensión, frecuencia de las deposiciones, consistencia de las deposiciones, e interferencia con las actividades cotidianas. Cada ítem se puntúa de 0 a 100 en una escala visual analógica, obteniéndose el sumatorio de las 5 puntuaciones. El *Irritable Bowel Syndrome Severity Scoring System* ha sido traducido y validado al español[31].

Diagnóstico

¿Cuántos tipos fisiopatológicos hay en el estreñimiento funcional (sin o con síndrome de intestino irritable)?

El EF se clasifica según los mecanismos fisiopatológicos implicados en tres grupos[2,32–35].

1. Pacientes con *trastorno funcional de la defecación* (tabla 3)[36]: en los que se detecta una alteración del vaciado rectal ocasionado por una insuficiente propulsión rectal o por un comportamiento anómalo de la relajación de la musculatura estriada responsable de la apertura del canal anal (déficit de relajación, contracción paradójica o disinergia de la defecación). Ambas disfunciones pueden asociarse y a menudo se acompañan de una disminución de la sensibilidad rectal (hiposensibilidad), defectos estructurales del suelo pélvico (descenso perineal excesivo, rectocele, enterocele, intususcepción, etc.) o por trastornos de la motilidad colónica con retraso del *tiempo de tránsito colónico* (TTC)[33].
2. Pacientes con *tránsito colónico lento* (TCL), en los que el tiempo que tarda el material intestinal en recorrer el colon está aumentado con respecto a la normalidad.
3. Pacientes con tránsito colónico normal (TCN).

El diagnóstico de estos subtipos fisiopatológicos precisa de técnicas diagnósticas funcionales complementarias que deben realizarse en centros especializados.

Tabla 3 Criterios de Roma IV para el diagnóstico de trastornos funcionales de la defecación (TFD)

1. El paciente debe cumplir los criterios diagnósticos de EF (tabla 2) y/o de SII-E (tabla 1)

Y además:

2. Durante intentos repetidos para defecar, debe haber elementos de evacuación inadecuada, demostrada por, al menos, dos de las siguientes pruebas:
   a. Prueba expulsiva con balón anormal
   b. Patrón de evacuación anorrectal anormal demostrado por manometría o por electromiografía anal de superficie
   c. Evacuación rectal alterada demostrada por medios de imagen
3. *Subcategorías* aplicables a los pacientes que satisfacen criterios de TFD. Criterios definidos por valores apropiados normales en función de edad y sexo para cada técnica:
   3 a. Criterios diagnósticos de propulsión defecatoria inadecuada

Fuerzas propulsivas inadecuadas medidas por manometría con o sin contracción inapropiada del esfínter anal y/o de los músculos del suelo pélvico

   3 b. Criterios diagnósticos de defecación disinérgica

Contracción inapropiada del suelo pélvico medida por electromiografía de superficie o por manometría con fuerzas propulsivas adecuadas durante el intento de defecación

Estos criterios deben cumplirse al menos durante los últimos tres meses y los síntomas deben haberse iniciado como mínimo seis meses antes del diagnóstico.
Fuente: Rao et al.[36].

¿Qué estudios funcionales permiten establecer el diagnóstico de disfunción de la defecación, en qué orden y dónde deben realizarse?

Hay tres técnicas exploratorias que nos sirven para hacer el diagnóstico, y aunque no existe consenso que permita unificar la metodología de cada una de ellas, es necesario verificar mediante como mínimo dos técnicas la presencia de una evacuación ineficaz[33].

El *test de expulsión del balón*, por su accesibilidad, sencillez, coste, ausencia de efectos secundarios, sensibilidad y especificidad diagnóstica, deberá ser siempre el primero en realizarse[33,35,37,38]. Aunque no requiere un centro especializado, en la práctica clínica es muy difícil que en asistencia primaria o en consulta especializada ambulatoria se realice. Este test consiste en evaluar la habilidad de un paciente para expulsar, en condiciones de intimidad, un globo lleno de agua a temperatura corporal y con un volumen suficiente como para producir deseos de defecación. Se considera normal, la expulsión en un tiempo máximo de 1 a 2 min. En un estudio no controlado, en pacientes con EF se ha observado que esta prueba es útil para identificar disfunción de la defecación y muestra una sensibilidad y especificidad del 87,5 y 89%, respectivamente, y unos valores predictivos positivos y negativos del 64 y 97%, respectivamente[39]. La probabilidad por tanto de que un paciente presente un trastorno de la expulsión si el estudio es normal es muy baja, sin embargo, cuando es patológica deberemos realizar una cuantificación meticulosa de

la función rectoanal que justifique esta alteración. El estudio más útil para ello es la *manometría ano-rectal*[33,35,37,38], que registra, tanto en reposo como durante la maniobra defecatoria espontánea o provocada tras la distensión de un balón intrarrectal, las presiones a lo largo del canal anal y del recto, valora la sensibilidad rectal e identifica la indemnidad de los reflejos rectoanales. En los pacientes con disinergia se objetivará la inadecuada relajación o la contracción paradójica del canal anal y la presencia o no de una presión intrarrectal suficiente para propulsar las heces. Tanto el test de la expulsión del balón como la manometría ano-rectal, presentan entre otros, el inconveniente de que se hacen con el canal anal ocupado permanentemente por una sonda y ello no garantiza que la maniobra defecatoria reproduzca la situación que el individuo experimenta en la vida cotidiana. Por ello, en caso de que los síntomas del paciente no se justifiquen con los hallazgos en ambos estudios, o exista divergencia en el resultado de los mismos, deberemos realizar una *defecografía*[34,40]. Esta técnica, permite estudiar además de la función, la anatomía del recto-ano durante el acto voluntario de la defecación. Existen dos técnicas para su realización, la videofluoroscopia, en la que se evalúa y cuantifica la capacidad de expulsar el contenido rectal (con el paciente sentado en un asiento radiotraslúcido) y además la existencia de alteraciones estructurales del sigma, recto y canal anal y la defecografía con resonancia magnética que además visualiza los tejidos blandos perirrectales y el sistema genitourinario en múltiples planos anatómicos, no utiliza radiación ionizante y es menos operador-dependiente que la videofluoroscopia. Ambas técnicas, deben hacerse en centros especializados y la interpretación de los resultados debe contrastarse siempre con los síntomas del paciente antes de tomar decisiones terapéuticas (sobre todo quirúrgicas), dada la alta prevalencia en sujetos normales de alteraciones morfológicas (rectocele, enterocele e intususcepción).

¿Qué estudios funcionales permiten establecer el diagnóstico de estreñimiento por tiempo de tránsito lento y dónde deben realizarse?

Existen tres técnicas que miden de forma cuantitativa el TTC total y en sus distintos segmentos: el *estudio radiológico con marcadores radiopacos*[41], la *evaluación gammagráfica del colon* tras la ingesta de una comida[42] o de una cápsula marcada con indio (111In-DTPA)[43], y el *estudio con cápsula inalámbrica de la motilidad* (SmartPill®)[44]. Todas las técnicas deben realizarse e interpretarse en centros especializados, si bien por accesibilidad el estudio con marcadores radiopacos es el más ampliamente utilizado.

En España, disponemos de un estudio con un número elevado de sujetos normales que nos proporciona valores de normalidad para los estudios radiológicos[41]. El uso de la SmartPill®, aunque de elevado coste, ha demostrado tener una buena correlación con los resultados de los estudios radiológicos para clasificar a los pacientes con TCL respecto a los de TCN, no es ionizante y mide además del tiempo la actividad motora en todo el tracto gastrointestinal. Este dato es muy importante cuando debemos decidir realizar cirugía exerética de colon en un paciente con TCL ya que previamente se deben descartar trastornos motores del resto del intestino.

¿Qué utilidad clínica tiene conocer el tipo fisiopatológico de estreñimiento funcional?

Es muy útil en la práctica clínica hacer lo antes posible el diagnóstico de pacientes con disfunción de la defecación por disinergia del suelo pélvico, por su prevalencia, porque responden a tratamiento con *biofeedback* (BFB) pero no lo hacen a tratamiento habitual[45–48] y además porque en un porcentaje elevado de pacientes la eficacia del BFB normaliza el TTC, cuando este estaba enlentecido[45].

En pacientes sin disfunción de la defecación conocer el TTC nos va a permitir ser más o menos agresivos en la actitud terapéutica. Los pacientes con TCN no deberían nunca tratarse con medidas extremas y aún menos mediante cirugía. Por otra parte, los pacientes con TCL sin disfunción de la defecación frecuentemente presentan empeoramiento clínico al tratamiento con fibra y responderán mal a los laxantes habituales (incluyendo los estimulantes). En este subgrupo de pacientes, se ha demostrado que la neuromodulación de raíces sacras[49] y de forma muy selectiva la colectomía subtotal con anastomosis íleo-rectal pueden ser tratamientos eficaces y satisfactorios[50,51].

¿Puede un paciente presentar cambios en sus síntomas y cumplir en diferentes etapas de su vida ambos diagnósticos (síndrome del intestino irritable con estreñimiento y el estreñimiento funcional)?

Aplicando los criterios diagnósticos de Roma (especialmente con criterios previos a Roma IV) es muy frecuente tanto el solapamiento diagnóstico como el cambio de diagnóstico en el mismo individuo a lo largo del tiempo. Uno de los estudios prospectivos más importantes realizados en asistencia primaria demostró (n: 432 pacientes; EF:231, SII-E:201), que el 89,5% de los pacientes con criterios de SII-E (tal y como eran definidos en 2005) cumplía así mismo criterios de EF y que el 43,8% de los pacientes con EF cumplían plenamente los criterios de SII-E, y además que el cambio en los diagnósticos en ambos sentidos (EF frente a SII-E y SII-E frente a EF) en un seguimiento de 12 meses se observaba hasta en un tercio de los pacientes[52].

¿Qué exploraciones complementarias son necesarias para el diagnóstico de síndrome del intestino irritable con estreñimiento y el estreñimiento funcional?

Como se ha comentado previamente, en la actualidad, el diagnóstico de SII-E y de EF se establecen mediante datos que se extraen de la historia clínica y que deben cumplir los criterios establecidos por consenso de grupos de expertos (Roma)[3] (tablas 1 y 2), o bien exclusivamente para EF, los criterios descritos previamente de la Asociación Americana de Gastroenterología[32].

Tabla 4 Enfermedades extraintestinales que pueden originar estreñimiento

Metabólicas y endocrinas
Diabetes mellitus
Hipotiroidismo
Insuficiencia renal crónica
Hiperparatiroidismo
Hipercalcemia
Hipopotasemia
Porfiria
Neurológicas centrales
Enfermedad de Parkinson
Accidente vascular cerebral
Enfermedades psiquiátricas
Esclerosis múltiple
Traumatismo medular
Tumores de la cola de caballo
Mielomeningocele
Tumores cerebrales
Síndrome de Shy-Drager
Tabes dorsal
Neurológicas periféricas
Neuropatía autonómica (paraneoplásica, pseudobstrucción)
Megacolon agangliónico congénito (enfermedad de Hirschsprung)
Hipoganglionosis
Hiperganglionosis
Ganglioneuromatosis (primaria, enfermedad de Von Recklinghausen, neoplasia endocrina múltiple 2 B)
Enfermedad de Chagas

Tabla 5 Fármacos asociados comúnmente con estreñimiento

- Analgésicos
  - Opiáceos
  - AINE
- Anticolinérgicos
- Antidepresivos tricíclicos
- Antipsicóticos
- Antiparkinsonianos
- Espasmolíticos
- Anticonvulsivantes
- Fármacos que contienen cationes, ej sucralfato, antiácidos que contienen aluminio, suplementos de hierro, litio, bismuto
- Antihipertensivos
  - Bloqueadores de los canales de calcio
  - Diuréticos
  - Antiarrítmicos
- Quelantes de las sales biliares
- Adrenérgicos
- Bifosfonatos

Tabla 6 Criterios de alarma que justifiquen la realización de estudios complementarios para descartar organicidad

- Antecedentes familiares o personales de cáncer colorrectal, poliposis intestinal, enfermedad inflamatoria intestinal y enfermedad celíaca
- Inicio de los síntomas a partir de los 50 años
- Cambios recientes del ritmo deposicional habitual
- Presencia de signos y síntomas que pueden indicar organicidad
  - Síntomas nocturnos
  - Fiebre
  - Anemia
  - Pérdida de peso no intencionada y no explicable por otras causas
  - Sangre en heces
  - Dolor abdominal importante
  - Exploración física con datos patológicos como: masa abdominal palpable, visceromegalias o un tacto rectal patológico

Una vez se constatan los criterios específicos que constituyen el diagnóstico de cualquiera de los dos procesos (SII-E y EF) y dado que es requisito imprescindible que el origen de los síntomas no tenga una justificación orgánica, metabólica ni farmacológica, debemos establecer criterios muy claros respecto a qué estudios complementarios son necesarios para garantizar la funcionalidad de los síntomas. La anamnesis dirigida y la exploración física rigurosa, son obligatorias y nos ayudan a confirmar la ausencia de enfermedades intestinales y extraintestinales (tabla 4) o de la toma de fármacos (tabla 5) que justifiquen los síntomas. Así mismo, nos permiten conocer si cumplen criterios de alarma (tabla 6) que favorezcan la realización específica de determinados estudios complementarios.

En ausencia de criterios de alarma ¿qué estudios de laboratorio o de imagen se consideran imprescindibles para descartar causalidad metabólica u orgánica en pacientes que cumplen los criterios clínicos consensuados de SII-E o de EF?

A excepción de un hemograma para evaluar la existencia de anemia y/o infección, no se ha demostrado que la realización de estudios en los que se determinen electrólitos, hormonas tiroideas, calcio y perfil bioquímico completo (glucosa en ayunas, urea, creatinina, etc.) tengan utilidad diagnóstica ni sean costo-eficaces[32,34,52]. De forma que estas pruebas solo deben solicitarse cuando exista una sospecha específica de alguno de los trastornos anteriores.

Tampoco se ha demostrado que la realización de radiología simple de abdomen[53,54] o de enema opaco[55] tenga utilidad para encontrar características morfológicas que les discriminen respecto a la población normal y no hay ninguna evidencia que soporte la utilidad de la realización de colonoscopia en pacientes con clínica de estreñimiento[56,57]. Por ello, las guías de consenso[32,34,40] no recomiendan realizar estudios de laboratorio ni morfológicos a excepción de que el médico observe criterios de riesgo o sospecha clínica de patología orgánica o metabólica.

¿Qué estudios debemos realizar si existen criterios de alarma?

Además de pedir las pruebas específicas en función del hallazgo guía de alarma, en la mayoría de los casos deberá realizarse una colonoscopia.

¿Qué controles de laboratorio o de imagen debemos hacer a los pacientes cuyo diagnóstico de SII-E o de EF tenga varios años de evolución y se mantenga clínicamente estable sin signos ni síntomas de alarma?

Ninguno. La única excepción es cuando el paciente cumpla criterios poblacionales de cribado de cáncer colorrectal por edad, o por la aparición en su entorno familiar de cáncer colorrectal. En estos casos deberán realizarse los estudios aplicables a cada caso: sangre oculta en heces o colonoscopia[34].

¿Qué controles debemos hacer en pacientes cuyo diagnóstico de SII-E o de EF esté bien establecido pero aparezcan cambios en la intensidad de los síntomas, en su frecuencia o en la respuesta al tratamiento?

En el supuesto de que no exista una explicación plausible para justificar los cambios, de forma individualizada se debe investigar la presencia de patología asociada que lo justifique. Es importante tener en consideración, tras una nueva exploración física, cuándo se realizaron los últimos estudios analíticos y morfológicos (si los tuviera) y si han cambiado las características epidemiológicas familiares. Característicamente, ambas patologías cursan con fases en las que hay cambios en la intensidad de los síntomas o en la percepción

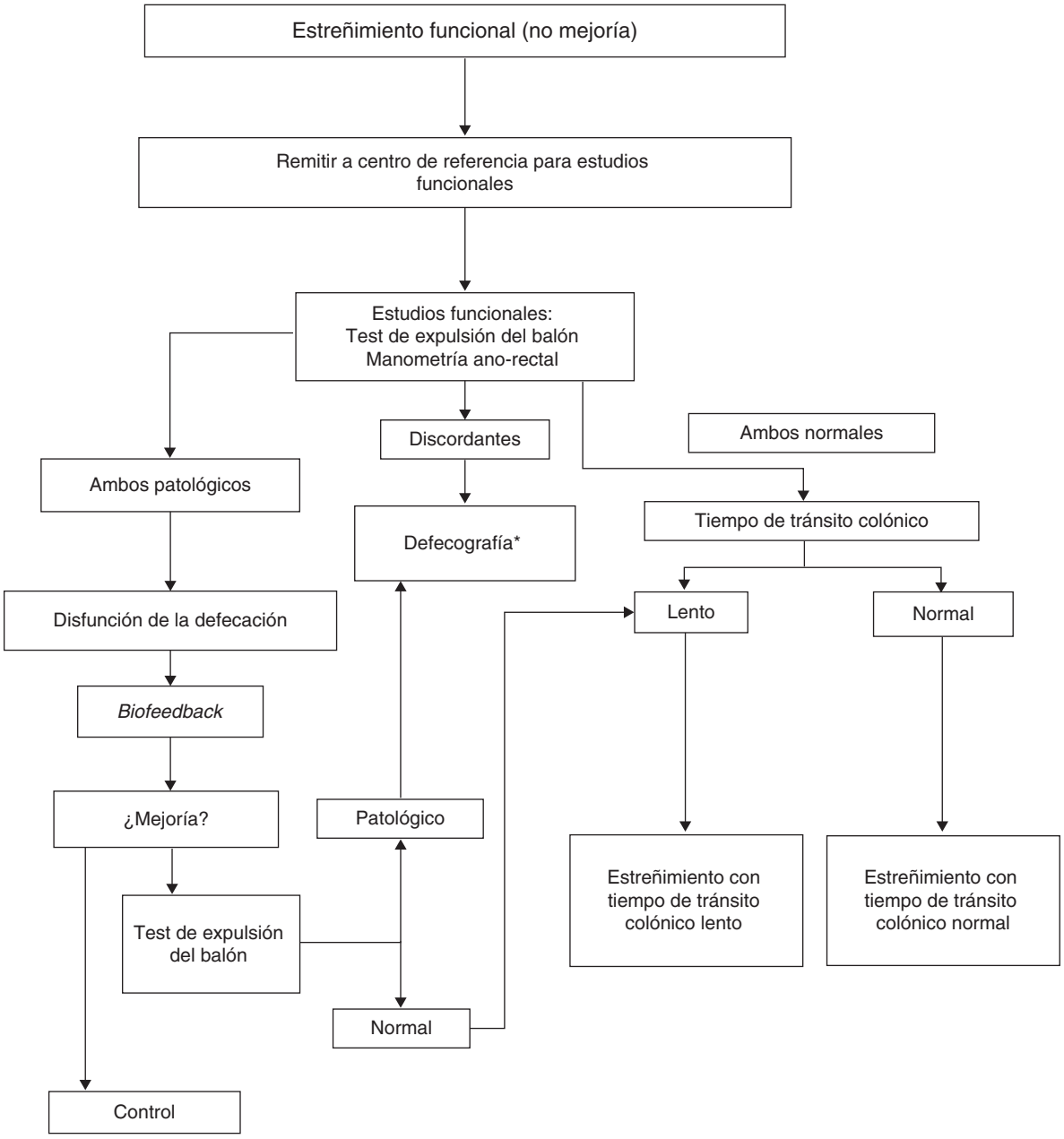

Figura 3 Algoritmo diagnóstico del estreñimiento funcional que no responde al tratamiento estándar y precisa de estudios funcionales.

* ver figura 4 de esta publicación.

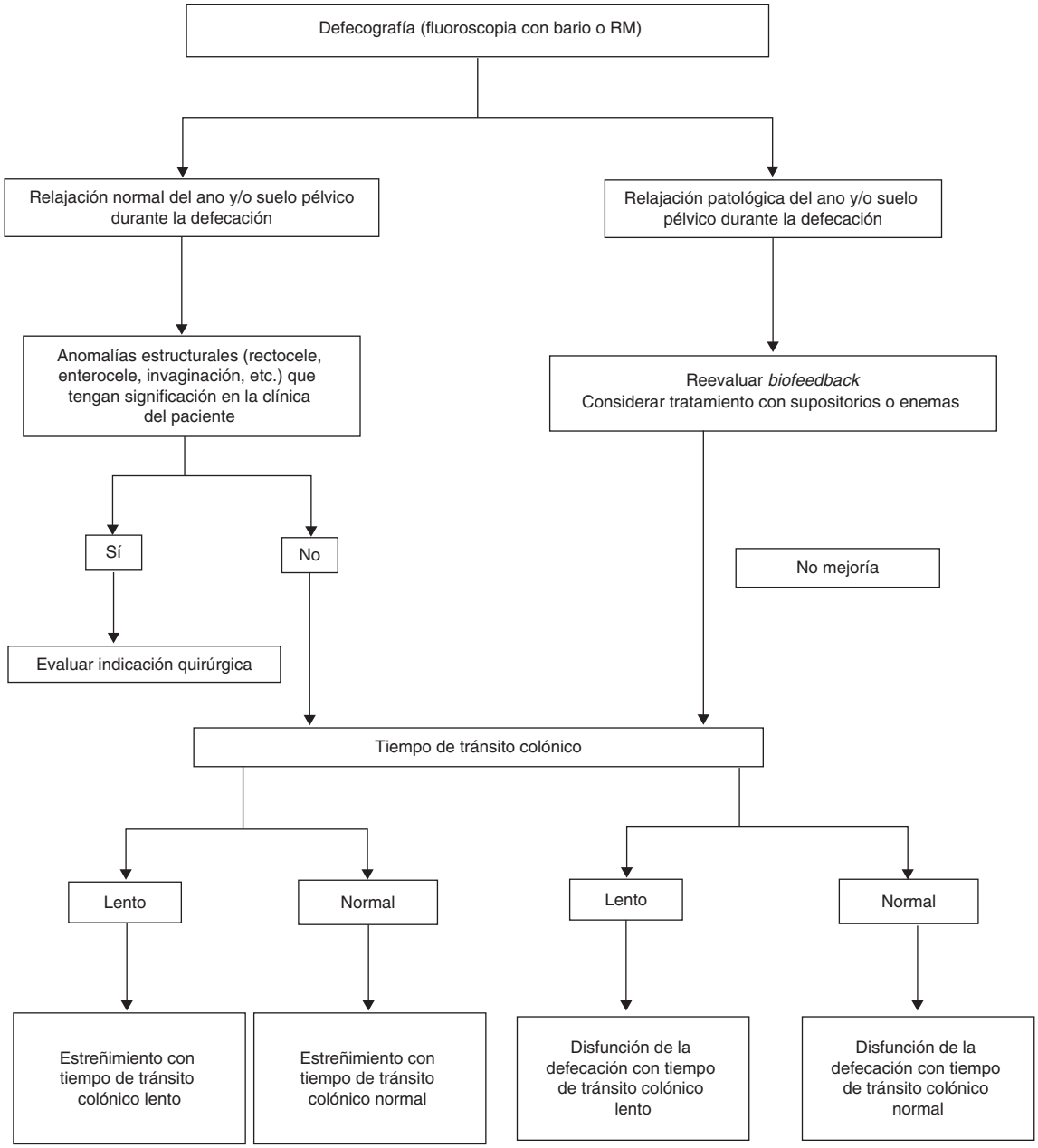

Figura 4 Algoritmo diagnóstico del EF en los pacientes evaluados mediante defecografía para evaluar con mayor profundidad posibles alteraciones anatomo-funcionales.

personal de que padecen una enfermedad orgánica no suficientemente investigada. Además, hay que tener en consideración que tanto el EF como el SII-E son diagnósticos intercambiables en el mismo individuo con el curso del tiempo si aplicamos los criterios diagnósticos de Roma, de manera que hasta un tercio de los pacientes con EF cumplirá criterios de SII-E en el seguimiento a un año y viceversa[5] y ello no debe ser motivo de exploraciones complementarias. Únicamente síntomas o signos de alarma justifican el hacer estas.

Una vez diagnosticado a un paciente de SII-E o de EF ¿qué estudios funcionales deberíamos realizar y cuándo? ¿Son útiles los síntomas para sospechar el mecanismo patogénico por el que se produce el EF?

Los pacientes con estreñimiento, cumplan criterios o no de SII, pueden presentar alteraciones funcionales rectoanales, o trastornos de la motilidad del colon que no van a responder a medidas habituales por lo que es necesario un diagnóstico específico mediante estudios funcionales (figs. 3 y 4). El trastorno funcional rectoanal más frecuente es la disfunción defecatoria por disinergia de la defecación, que afecta entre un 14,9 y un 52,9% de pacientes con EF[38] y que consiste básicamente en una alteración de la apertura del ano en el momento de la defecación o en una insuficiente propulsión rectal en la fase expulsiva. El diagnóstico precoz de este trastorno es muy importante dado que precisa un tratamiento específico (BFB ano-rectal). Existen datos en la historia clínica, que aunque no son específicos para el

diagnóstico de disinergia ano-rectal[58,59], son más frecuentes en esta entidad, como se ha señalado en algunos estudios, como son el dolor anal con la defecación[8], la ayuda manual para la expulsión de las heces, el esfuerzo excesivo para defecar y el bloqueo anal[60]. Además, hay un signo que se relaciona fuertemente con este trastorno cuando lo detectan profesionales experimentados, y es el hecho de objetivar una contracción paradójica del ano al invitar al paciente a efectuar una maniobra defecatoria durante la realización de un tacto ano-rectal[61,62]. Si el paciente presenta este signo, realizado por personal experto, y en condiciones de intimidad deberemos solicitar un test funcional de expulsión del balón y si este es patológico una manometría ano-rectal para confirmar el diagnóstico de disinergia. Sin embargo, y dado que en la práctica clínica estos requisitos (experiencia en tacto ano-rectal dinámico, áreas de exploración bien acondicionadas) no suelen darse, las guías de práctica clínica estiman que estas pruebas deben solicitarse ante cualquier paciente que no haya respondido a tratamiento con medidas higiénico-dietéticas, cambios en el estilo de vida y laxantes habituales y en el que por los síntomas o el tacto anal se sospeche la existencia de disinergia[34,38]; siendo más rigurosos, incluso puede exigirse antes de realizar estas exploraciones a los pacientes también refractarios a los tratamientos con agonistas de la serotonina y secretagogos[40]. En los pacientes en los que exista discordancia en los resultados del test de expulsión del balón y la manometría ano-rectal, se debe solicitar una defecografía mediante fluoroscopia o RM con el fin de evaluar la presencia de alteraciones estructurales ocultas (enterocele, intususcepción, rectocele) y/o confirmar la existencia de disfunción de la musculatura pelviana durante la maniobra de defecación.

Hay síntomas que en algunas series observacionales son más prevalentes en pacientes con EF con un TCL: la infrecuencia defecatoria[60,63], el estreñimiento desde la infancia y la dependencia de los laxantes[63], pero únicamente la consistencia de las heces (muy duras, escala de Bristol < 3) se ha objetivado que tiene un valor predictivo para el diagnóstico de TCL (sensibilidad 85%, especificidad 82%)[64]. En el momento actual el estudio del TTC se debe realizar en los pacientes que no responden a ninguna medida terapéutica y siempre después y aconsejando además descartar la existencia de disinergia ano-rectal mediante el estudio específico realizado mediante el test de expulsión del balón y la manometría ano-rectal[32,34,40].

¿Se puede, en una consulta de Atención Primaria diagnosticar subtipos fisiopatológicos de estreñimiento funcional? ¿Cómo?

Por criterios diagnósticos, los subtipos fisiopatológicos de estreñimiento precisan de técnicas diagnósticas que no están accesibles en la consulta de AP, sin embargo, existen síntomas o signos exploratorios básicos que han demostrado tener una correlación bastante buena con los resultados de estas técnicas. Dada la importancia que podría tener desde el punto de vista pronóstico y fundamentalmente terapéutico priorizar en función de la sospecha estudios específicos, es muy importante conocer e identificar estos síntomas y signos.

Para poder efectuar una aproximación diagnóstica en AP de los diferentes subtipos de EF deberemos realizar una historia clínica y una exploración física minuciosas. En la anamnesis es trascendental conocer el patrón defecatorio habitual (frecuencia y consistencia de las heces), los síntomas y signos acompañantes (dolor, malestar, distensión abdominal, esfuerzo defecatorio, sensación de evacuación incompleta, manualización para defecar, etc.) así como los antecedentes personales de tratamientos previos (cambios de estilo de vida, cambios dietéticos, laxantes, fármacos analgésicos, antidepresivos, etc.) y la respuesta obtenida. La exploración física ha de incluir una exploración abdominal completa, una inspección anal y perineal y un tacto rectal dinámico (con maniobra defecatoria)[65].

Con estos datos, como se ha comentado en el apartado anterior, se obtendrán síntomas que por su prevalencia en subtipos de EF sugieren la existencia de una disinergia de la defecación o de un TCL y fundamentalmente un signo (la disinergia anal durante el tacto ano-rectal) que tiene valor predictivo, en manos expertas, para el diagnóstico de disinergia de la defecación.

Tratamiento (ver publicación 2.ª parte; incluye preguntas 13-34 y nuevas tablas y figuras).

Coordinación entre niveles asistenciales

¿Cuándo se debe derivar a un paciente con síndrome del intestino irritable con estreñimiento o con estreñimiento funcional a una consulta especializada? Diagnóstico y coordinación entre niveles asistenciales

El diagnóstico del SII-E o del EF queda bien establecido en los criterios propuestos por el panel de expertos de Roma (figs. 2-4, y tablas 1 y 2). Sin embargo, el profesional de AP siempre ha de tener presentes diferentes situaciones en las que ha de valorar la derivación a la atención especializada fundamentalmente para descartar organicidad pero también, en algunas ocasiones, para optimizar el seguimiento y el tratamiento de estos pacientes en el marco de una atención integrada y compartida. Para ello, resulta imprescindible una anamnesis adecuada incluyendo antecedentes familiares y personales, investigar la presencia de síntomas y signos de alarma y una exploración física minuciosa.

Diferentes documentos de consenso y GPC establecen diferentes motivos que obligan a descartar patología orgánica aunque la precisión diagnóstica de alguno de ellos es controvertida (tabla 6).

También pueden ser motivo de derivación a una consulta especializada la presencia de síntomas persistentes o con mala respuesta al tratamiento, un deterioro importante de la calidad de vida, la no accesibilidad a pruebas diagnósticas o a dudas en el diagnóstico[34,39,40,66–72].

¿Cuándo se debe derivar a un paciente con SII-E o con EF, con diagnóstico de certeza a una consulta de gastroenterología o de otras especialidades?

En la actualidad, pueden existir vías de actuación diferentes en cada departamento o área asistencial, en función de la existencia o no de protocolos de actuación. Lo ideal, es crear unos sistemas de actuación por procedimientos según

Tabla 7 Criterios de derivación de pacientes con criterios de SIIE/EF de Atención Primaria a Aparato Digestivo

1.- Cuando por anamnesis detallada, exploración física minuciosa o evaluación de estudios analíticos de rutina se considere que es imprescindible descartar patología orgánica que precise métodos diagnósticos o estudios funcionales no accesibles desde Atención Primaria
2.- Pacientes no respondedores o intolerantes a tratamiento con medidas básicas higiénico-dietéticas, cambios de estilo de vida, laxantes habituales y espasmolíticos o antidepresivos
3.- Sospecha de disfunción de la defecación que precise estudios para conocer su fisiopatología
4.- Empeoramiento de la clínica no justificable
5.- Necesidad incuestionable, por la actitud del paciente, de una segunda opinión especializada

los cuales, el médico de AP tenga acceso directo al especialista de digestivo con el fin de consultar cambios en el tratamiento o derivar al paciente para la realización de estudios complementarios o tratamientos específicos únicamente accesibles a asistencia especializada.

En este sentido, sería razonable la derivación del paciente en los siguientes supuestos (ver también tabla 7):

a) No respondedores o intolerantes a tratamiento con medidas básicas higiénico-dietéticas, cambios de estilo de vida y laxantes habituales incluyendo tratamiento de rescate con laxantes estimulantes (bisacodilo y picosulfato sódico). En el supuesto de que existan vías de acceso no presenciales, la prescripción de fármacos agonistas de la serotonina o secretagogos puede realizarse por el médico de atención primaria consensuando con el especialista el seguimiento. En los pacientes con SII-E se incluirán los no respondedores a tratamiento con espasmolíticos o con antidepresivos.
b) Pacientes con una exploración ano-rectal en los que se sospeche la existencia de una disfunción de la defecación.
c) Pacientes que con un control satisfactorio de los síntomas, experimenten un empeoramiento no justificable. En estos casos la derivación puede ser bien al especialista de digestivo o en función de síntomas o signos asociados a consultas específicas (endocrino, ginecología, cirugía, psiquiatría, etc.).
d) Pacientes, cuyas características psicológicas, actitud frente a los síntomas o cuestionamiento en la búsqueda constante de la organicidad de sus molestias requieran el refuerzo de la opinión de un especialista.

Conflicto de intereses

Los autores firmantes de esta Guía de práctica clínica (GPC) lo hacen en nombre de la Sociedad Española de Patología Digestiva (SEPD), la Sociedad Española de Medicina de Familia y Comunitaria (semFYC), la Sociedad Española de Médicos de Atención Primaria (SEMERGEN), la Sociedad Española de Médicos Generales y de Familia (SEMG) o como socios de la Asociación Española de Gastroenterología (AEG). Ni estas sociedades científicas ni ninguno de los integrantes del grupo de trabajo tienen vinculación alguna con las compañías que desarrollan los fármacos para las patologías abordadas en esta GPC. La SEPD, la semFYC, la SEMERGEN y la SEMG, así como los componentes del grupo pertenecientes a las mismas, no tienen intereses económicos en las compañías que han realizado la investigación y distribuyen medicamentos para estas patologías del aparato digestivo, si bien mantienen, tanto sociedades como integrantes del grupo, una sostenida relación con las mismas en la promoción de formación, investigación y mejora de la práctica clínica hacia la promoción de la salud digestiva. Finalmente, la SEPD, la semFYC, la SEMERGEN y la SEMG, así como los autores firmantes declaran que este trabajo ha recibido financiación de Almirall y Allergan, que ha carecido de cualquier tipo de influencia externa en el mismo y que ninguna tercera parte ha participado en la deliberación ni desarrollo del mismo ni ha conocido el contenido del texto final, antes de su publicación efectiva en la Revista Española de Enfermedades Digestivas y resto de órganos de expresión de cada sociedad participante.

Agradecimientos

Los autores agradecen la colaboración de los responsables de las cuatro Sociedades Científicas de las que forman parte, así como el trabajo de apoyo de Marién Castillo Sánchez, de Joaquín León Molina en la gestión bibliográfica y de José María Tenías en el soporte metodológico. También agradecen especialmente las sugerencias y comentarios de los siguientes revisores externos: Agustín Balboa Rodríguez, R. Manuel Devesa Muñiz, Higinio Flores Tirado, Juan Manuel Mendive Arbeloa, Xavier Puigdengolas Armengol, Mercedes Ricote Belinchón, Cecilio Santander Vaquero, Jordi Serra Pueyo, Carlos A. Siljeström Laredo, María José Soria de la Cruz.

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Semergen. 2017;43(2):123–140

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DOCUMENTO DE CONSENSO

Guía de práctica clínica del síndrome del intestino irritable con estreñimiento y estreñimiento funcional en adultos: tratamiento. (Parte 2 de 2)☆

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PALABRAS CLAVE
Síndrome del intestino irritable;
Estreñimiento funcional;
Molestia abdominal;
Adultos;
Atención Primaria;
Enfermedades digestivas;
Guía de práctica clínica;
Roma IV

Resumen En esta Guía de práctica clínica analizamos el manejo diagnóstico y terapéutico de pacientes adultos con estreñimiento y molestias abdominales, bajo la confluencia del espectro del síndrome del intestino irritable y el estreñimiento funcional. Ambas patologías están encuadradas en los trastornos funcionales intestinales y tienen una importante repercusión personal, sanitaria y social, afectando a la calidad de vida de los pacientes que las padecen. La primera es el subtipo de síndrome del intestino irritable en el que el estreñimiento es la alteración deposicional predominante junto con dolor abdominal recurrente, hinchazón y distensión abdominal frecuente. El estreñimiento se caracteriza por la dificultad o la escasa frecuencia en relación con las deposiciones, a menudo acompañado por esfuerzo excesivo durante la defecación o sensación de evacuación incompleta. En la mayoría de los casos no tiene una causa orgánica subyacente, siendo considerado un trastorno funcional intestinal. Son muchas las similitudes clínicas y fisiopatológicas entre ambos trastornos, con respuesta similar del estreñimiento a fármacos comunes, siendo la diferencia fundamental la presencia o ausencia de dolor, pero

☆ Este trabajo se publica conjuntamente por la SEPD, la semFYC, la SEMERGEN y la SEMG. La publicación original íntegra se realizó por la SEPD en (1): Rev Esp Enferm Dig 2016; 108(6): 332-363. semFYC, SEMERGEN y SEMG publican el trabajo en dos partes, para accesibilidad de sus respectivos socios. Tras la publicación de la primera parte (96-98), aquí se publica la segunda.

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◊ SEPD: Sociedad Española de Patología Digestiva; semFYC: Sociedad Española de Medicina de Familia y Comunitaria; SEMERGEN: Sociedad Española de Médicos de Atención Primaria; SEMG: Sociedad Española de Médicos Generales y de Familia.

http://dx.doi.org/10.1016/j.semerg.2017.01.001

no de un modo evaluable como «todo o nada». La gravedad de estos trastornos depende no solo de la intensidad de los síntomas intestinales sino también de otros factores biopsicosociales: asociación de síntomas gastrointestinales y extraintestinales, grado de afectación, y formas de percepción y comportamiento. Mediante los criterios de Roma, se diagnostican los trastornos funcionales intestinales. Esta Guía de práctica clínica está adaptada a los criterios de Roma IV difundidos a finales de mayo de 2016. En una primera parte (96, 97, 98) se analizaron los aspectos conceptuales y fisiopatológicos, los criterios de alarma, las pruebas diagnósticas y los criterios de derivación entre Atención Primaria y aparato digestivo. En esta segunda parte, se revisan todas las alternativas terapéuticas disponibles (ejercicio, ingesta de líquidos, dieta con alimentos ricos en fibra soluble, suplementos de fibra, otros componentes de la dieta, laxantes osmóticos o estimulantes, probióticos, antibióticos, espasmolíticos, esencia de menta, prucaloprida, linaclotida, lubiprostona, *biofeedback*, antidepresivos, tratamiento psicológico, acupuntura, enemas, neuroestimulación de raíces sacras o cirugía), efectuando recomendaciones prácticas para cada una de ellas.

KEYWORDS
Irritable bowel syndrome;
Functional constipation;
Abdominal discomfort;
Adults;
Primary care;
Digestive diseases;
Clinical practice guide;
Rome IV

Irritable bowel syndrome with constipation and functional constipation in adults: Treatment (Part 2 of 2)

Abstract In this Clinical practice guide we examine the diagnostic and therapeutic management of adult patients with constipation and abdominal discomfort, at the confluence of the spectrum of irritable bowel syndrome and functional constipation. Both fall within the framework of functional intestinal disorders and have major personal, health and social impact, altering the quality of life of the patients affected. The former is a subtype of irritable bowel syndrome in which constipation and altered bowel habit predominate, often along with recurring abdominal pain, bloating and abdominal distension. Constipation is characterised by infrequent or hard-to-pass bowel movements, often accompanied by straining during defecation or the sensation of incomplete evacuation. There is no underlying organic cause in the majority of cases; it being considered a functional bowel disorder. There are many clinical and pathophysiological similarities between the two conditions, the constipation responds in a similar way to commonly used drugs, the fundamental difference being the presence or absence of pain, but not in an ''all or nothing'' way. The severity of these disorders depends not only on the intensity of the intestinal symptoms but also on other biopsychosocial factors: association of gastrointestinal and extraintestinal symptoms, degree of involvement, forms of perception and behaviour. Functional bowel disorders are diagnosed using the Rome criteria. This Clinical practice guide adapts to the Rome IV criteria published at the end of May 2016. The first part (96, 97, 98) examined the conceptual and pathophysiological aspects, alarm criteria, diagnostic test and referral criteria between Primary Care and Gastroenterology. This second part reviews all the available treatment alternatives (exercise, fluid ingestion, diet with soluble fibre-rich foods, fibre supplements, other dietary components, osmotic or stimulating laxatives, probiotics, antibiotics, spasmolytics, peppermint essence, prucalopride, linaclotide, lubiprostone, biofeedback, antidepressants, psychological treatment, acupuncture, enemas, sacral root neurostimulation and surgery), and practical recommendations are made for each.

Nota metodológica

Esta Guía de práctica clínica (GPC) ha sido desarrollada entre enero de 2015 y diciembre de 2015 por un grupo de trabajo formado por expertos seleccionados por la Sociedad Española de Patología Digestiva (SEPD), la Sociedad Española de Medicina de Familia y Comunitaria (semFYC), la Sociedad Española de Médicos de Atención Primaria (SEMERGEN) y la Sociedad Española de Médicos Generales y de Familia (SEMG). Entre diciembre de 2015 y abril de 2016 ha sido sometida a revisión, con la última adaptación a Roma IV en mayo de 2016[1,2].

Para un detalle del proceso metodológico de trabajo mediante el cual se ha elaborado esta GPC ver http://www.sepd.es/file/GPC_SII_E_EF_Metodologia.pdf

Aspectos conceptuales, impacto y fisiopatología

Para acceder al apartado de *Aspectos conceptuales, impacto y fisiopatología* (preguntas 1-7; figuras 1 A y B y figura 2; tablas 1 y 2 de la Parte 1), ver las publicaciones correspondientes (96–98).

Diagnóstico

Para acceder al apartado de *Diagnóstico* (preguntas 8-12; figuras 3 y 4; tablas 3 a 6 de la Parte 1), ver las publicaciones correspondientes (96–98).

Tratamiento

Importancia del cumplimiento terapéutico y aspectos prácticos generales para cualquier alternativa terapéutica

Como en cualquier otra patología, el cumplimiento terapéutico estricto es imprescindible para conseguir la eficacia del plan terapéutico prescrito. En el caso de los procesos que nos ocupan, incluye no solo la toma de fármacos sino el seguimiento de los consejos higiénico-dietéticos pautados (tabla 1) y la modificación de los estilos de vida cuando ello procede.

Es cierto que no basta con plantear dicho plan terapéutico (figs. 1 y 2), porque resultará del todo inútil si el paciente no lo asimila, lo admite y acepta ponerlo en práctica. Por tanto, no se trata de que el paciente adopte una conducta de sumisión o de obediencia a la prescripción, sino que se debe conseguir el clima adecuado entre médico y paciente que conlleve la colaboración y la participación activa de este en la toma de decisiones y en la asunción de su propia responsabilidad sobre el cuidado o la mejora de su salud.

Por ello, además de tomar en consideración las mejores opciones terapéuticas desde el punto de vista objetivo, es preciso valorar otras cuestiones que facilitarán el compromiso y con ello el cumplimiento por parte del paciente. Entre ellas son interesantes las siguientes:

Tabla 1 Medidas higiénico-dietéticas en el SII-E/EF

- Ingesta de 25-30 g de fibra soluble con la dieta al día
- Ingesta adecuada de líquido (1,5-2 l al día)
- Ejercicio aeróbico regular (ajustado a las condiciones físicas de cada individuo y a sus preferencias)
- Dieta equilibrada
- Patrón regular de comidas
- Evitar comidas copiosas, grasas, fibra insoluble y alimentos flatulentos
- En algunos pacientes el sorbitol, las grasas, el alcohol, el trigo, los frutos secos o la leche pueden exacerbar la sintomatología del SII, aunque las dietas con exclusión de estos alimentos no han mostrado resultados concluyentes

- Pautar fármacos cuya posología sea simple, con el menor número posible de tomas o empleando formulaciones galénicas que la simplifiquen (tablas 2 y 3).
- Facilitar al paciente información y recordatorios escritos, simples y de fácil comprensión.
- Elaborar «calendarios» de cumplimiento mediante los cuales monitorizar la toma de medicación o la realización de actividades pautadas.
- Proveer al paciente de información acerca de la fisiopatología de su proceso, adaptada a su idiosincrasia y nivel cultural, de manera que se sienta implicado en la evolución de su enfermedad.
- Incluir en todas estas estrategias a los familiares y cuidadores de manera que también actúen como refuerzo positivo de la actitud del paciente.
- Es muy importante la regularidad en el tratamiento indicado para el estreñimiento. Mientras unos pacientes se automedican permanentemente con laxantes estimulantes, otros los utilizan solo de forma intermitente y puntual ante agravamientos y, con cierta frecuencia, algunos pacientes evitan la toma de cualquier tratamiento con el concepto erróneo de que los laxantes producen dependencia o pueden resultar peligrosos.

Por último, conviene recordar que el personal de enfermería puede desempeñar un papel muy eficaz en la educación sanitaria y en el seguimiento de la evolución de estos pacientes.

En todo caso, es inútil intentar valorar la eficacia del plan terapéutico sin asegurar el óptimo cumplimiento del mismo por parte del paciente. Su falta de eficacia no será mejorada con modificaciones aisladas o globales de la prescripción si no es factible garantizar la mejor disponibilidad del paciente para comprometerse con dicho plan terapéutico.

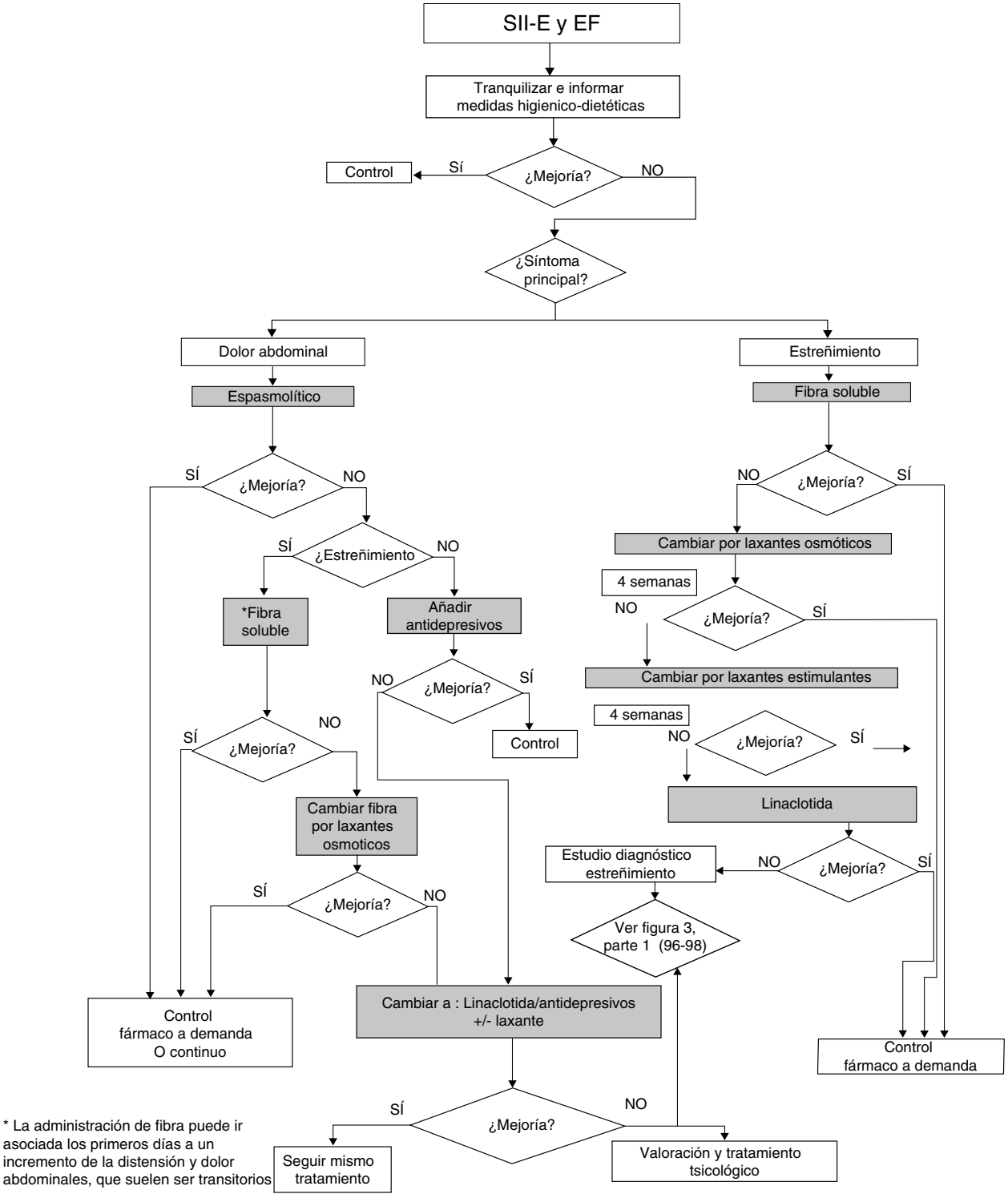
Utilidad del ejercicio físico aeróbico para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión

Se suele recomendar la realización de ejercicio físico de forma empírica para mejorar el estreñimiento y la distensión abdominal. El ejercicio físico aeróbico es útil para mantener una adecuada función intestinal y reducir el estrés[3].

Eficacia. Un programa regular de actividad física aeróbica (caminar, bicicleta) puede ser eficaz en el estreñimiento, ya que se ha observado una mejoría en el TTC total y en rectosigma[4]. También se ha señalado su efecto beneficioso en la distensión abdominal y la retención de gas[5], aunque en menor grado que en los sujetos sanos[6]. En otros dos estudios se demostró una mejoría global de los síntomas en el síndrome del intestino irritable (SII) y en la consistencia de las heces[7,8]. Además, también mejoraron otros aspectos que pueden influir en el SII, como la ansiedad y la depresión[7].

Limitaciones. La práctica moderada y regular de ejercicio físico aeróbico ajustada a las condiciones físicas de cada individuo, no tiene grandes limitaciones clínicas, salvo en pacientes con alteración de la movilidad. Sin embargo, está por determinar la intensidad y la duración óptima del mismo.

Recomendaciones prácticas. El ejercicio físico aeróbico practicado de forma regular puede ser útil en la mejoría



No mejoría: paciente que cumplimentando adecuadamente el tratamiento no alcanza una mejoría satisfactoria de los síntomas o presenta efectos secundarios que impiden continuarlo (distensión, dolor abdominal, diarrea, etc.)

Figura 1 Tratamiento del SII-E y del EF.

del estreñimiento, favorece la evacuación del gas intestinal y mejora la distensión, por lo que parece recomendable aconsejar su práctica en los pacientes con síndrome del intestino irritable con (predominio de) estreñimiento (SII-E) y estreñimiento (crónico) funcional (EF).

¿El aumento en la ingesta de líquidos mejora el estreñimiento?

La mayoría de las guías clínicas recomiendan realizar modificaciones en el estilo de vida, como la adecuada ingesta de

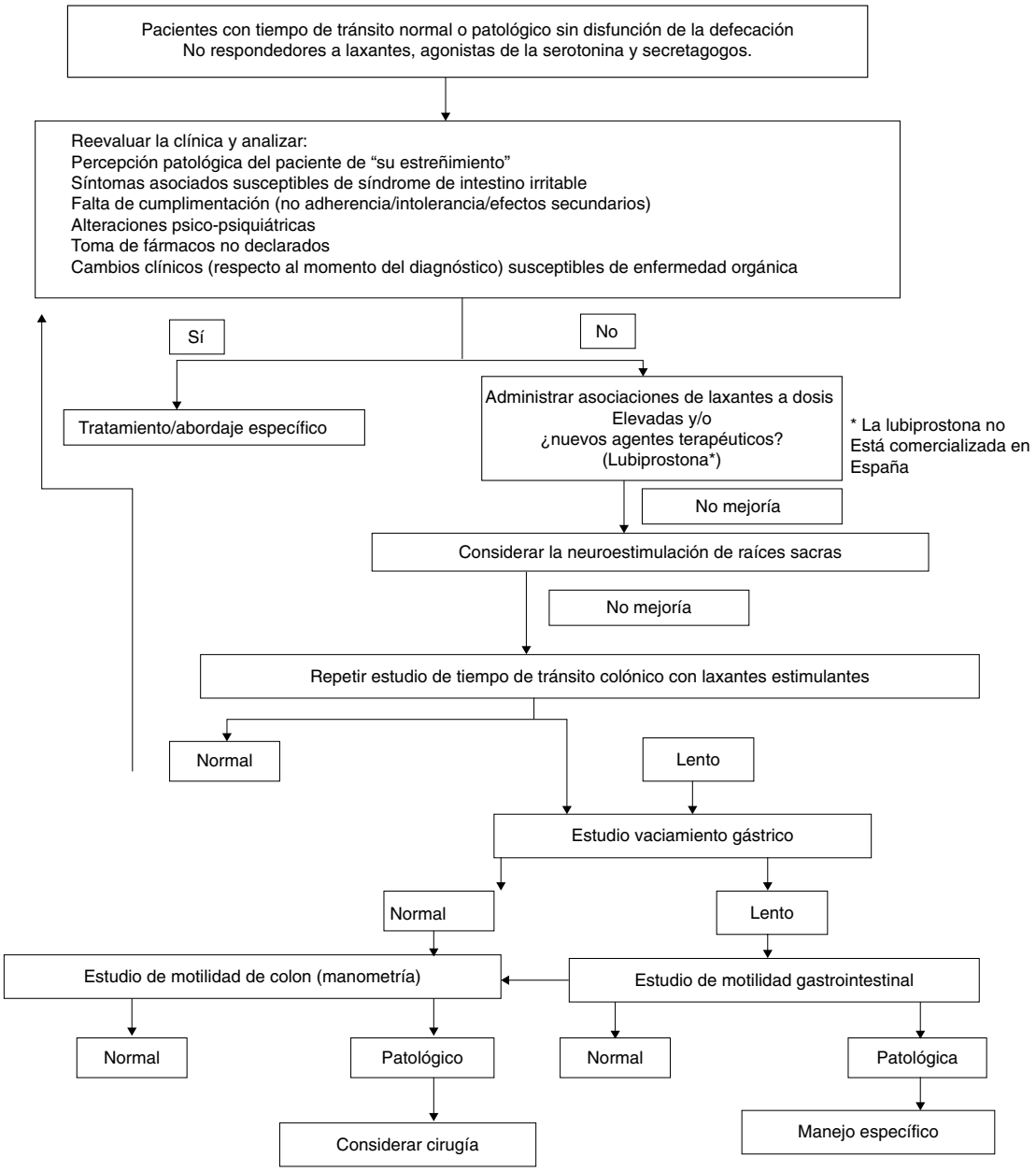


Figura 2 Algoritmo terapéutico del EF no respondedor.

líquidos y de una dieta rica en fibra. En concreto, se suele recomendar beber de 1,5-2 L de líquido al día según algunas guías[9–11] y otras revisiones más específicas sobre el EF en ancianos[12].

Eficacia y limitaciones. En un estudio aleatorizado, la ingesta de 2 L de agua al día en pacientes con EF, que ya estaban consumiendo una dieta rica en fibra, mejoró la frecuencia defecatoria y la necesidad de laxantes[13]. Sin embargo, no se dispone de ensayos clínicos que demuestren que la ingestión de líquidos en sí misma, sin otras medidas adicionales, mejore el estreñimiento, salvo en pacientes deshidratados[9,14].

Recomendaciones prácticas. Aunque la evidencia para recomendar el aumento de la ingesta de líquidos es insuficiente, esta medida sí que puede ofrecer algún beneficio en casos de estreñimiento leve asociada al adecuado consumo de fibra con la dieta.

Utilidad de fibra en la dieta para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión

En la mayoría de las guías se recomienda la dieta rica en fibra como medida inicial para mejorar el estreñimiento. Se suele aconsejar un aumento gradual de la misma para evitar la distensión abdominal; la cantidad de fibra recomendada al día es de unos 25-30 g. Sin embargo, aunque esta medida puede mejorar la frecuencia defecatoria y la consistencia de las heces, puede empeorar otros síntomas como el dolor y la distensión abdominal.

Tabla 2 Fármacos utilizados en el SII-E y EF

Fibra soluble (formadores de bolo)		
Nombre comercial	Principio activo	Dosis
Biolid® sobres 3,5 g Metamucil® sobres 3,26 g Plantaben® sobres 3,5 g Plantago ovata EGF sobres 3,5 g	Ispagula (plantago ovata) Cutícula	3,2 a 10,5 g/24 h
Cenat® envase 250/400 g	Ispagula (plantago ovata) Semilla	10 g/24 h
Muciplazma® cápsulas 500 mg	Metilcelulosa	1,5 g/8 h
Laxantes osmóticos		
Nombre comercial	Principio activo	Dosis
Emportal® polvo para solución oral 10 g Oponaf® polvo para solución oral 10 g	Lactitol	10-20 g/24 h
Duphalac® sobres 10 g, suspensión Lactulosa EFG sobres 10 g, suspensión	Lactulosa	15-30 g/24 h
Magnesia cinfa® sobres 2,4 g, suspensión oral 200 mg/ml Magnesia San Pellegrino polvo ® 2,24 g Magnesia lainco® sobres 2,4 g	Hidróxido de magnesio	2,4 g 1 a 3 dosis/24 h
Casenglicol® gel, polvos	Polietilenglicol/macrogol 4000	
Casenlax® polvo 10 g	Polietilenglicol/macrogol 4000	10-20 g/24h
Movicol® sobres 13.8 g	Polietilenglicol/macrogol 3350	13,8-41,4g/24h
Molaxole® sobres 13,8 g	Politetilenglicol/macrogol 3350	13,8-41,4g/24h
Laxantes estimulantes (difenilmetanos)		
Nombre comercial	Principio activo	Dosis
Bisacodilo comp. 5 mg, sup. 10 mg	Dulcolaxo	5-10 mg/24 h
Evacuol gotas 7,5 mg/ml	Picosulfato sódico	5-10 gotas/24 h
Espasmolíticos antagonistas de canales del calcio		
Nombre comercial	Principio activo	Dosis
Spasmoctyl®, grágeas 40 mg	Bromuro de otilonio	40 mg/12-8 h
Eldicet® comp. 50 mg	Bromuro de pinaverio	50 mg/8 h
Relajantes directos del músculo liso		
Nombre comercial	Principio activo	Dosis
Duspatalín® comp. 135 mg	Mebeverina	135 mg/8 h
Anticolinérgicos/antimuscarínicos		
Polibutin® comp. 100 mg y suspensión 24mg/5 ml	Trimebutina	100-200 mg/8-12 h
Buscapina® sup. 10 mg; comp. 10 mg.	Metilbromuro de butilescopolamina	10 a 20 mg/8 h
Esencia de menta		
Nombre comercial	Principio activo	Dosis
Menta Gotas® 30 ml	Aceite de menta	15-30 gotas/1-3 veces día
Iberogast® 20/50/100 ml	Menta y otros*	20 gotas/8 h
(Alcaravea, Angélica archangélica raíz, Cardo mariano, Celidonia, Iberis amara, Manzanilla, Melissa officinalis hojas, Regaliz)*		
Antidepresivos (clase IRSS más utilizados)		
Nombre comercial	Principio activo	Dosis
Citalopram EGF comp. 10 mg y varias marcas	Citalopram	10-20 mg/24 h
Paroxetina EGF comp. 20 mg y varias marcas	Paroxetina	10-40 mg/24

Tabla 2 (*continuación*)

Secretagogos		
Nombre comercial	Principio activo	Dosis
Constella ® cápsulas 290 mg	Linaclotida	290 mg/24 h
Amitiza® comp. 24 mcg*	Lubiprostona	24 mcg/12 h
Procinéticos		
Nombre comercial	Principio activo	Dosis
Resolor ® comp. 1-2 mg	Prucaloprida	2 mg/24 h
Antibióticos		
Nombre comercial	Principio activo	Dosis
Spiraxin® comp. 200 mg	Rifaximina	4 0 0 mg/8-12h

* No comercializado en España. Se utiliza como medicación extranjera.

Tabla 3 Mecanismo de acción de los fármacos utilizados frecuentemente en el SII-E y EF

Tratamiento	Reducción dolor	Reducción distensión abdominal	Aumento frecuencia deposicional	Esfuerzo defecatorio
Fibra (Psyllium) (2-5 sobres/día)	0	-	+	+
Espasmolíticos (2-4 comp./día)	+	+	0	0
Laxantes (1 - 3 comp. o sobres/día)	0	0	++	++
Procinéticos (Prucaloprida) (1 comp./día)	+	+	++	0
Secretagogos (Linaclotide) (1 comp/día)	++	++	++	+
Antidepresivos (ISRS) (1 comp/día)	+	0	nc	nc

nc: datos no concluyentes.

Eficacia. En un metanálisis se concluyó que el consumo de ciruelas secas (100 g/día) fue beneficioso para mejorar el estreñimiento y que este efecto fue incluso superior al obtenido con *psyllium*[15].

En otro metanálisis la dieta rica en fibra fue útil para mejorar el estreñimiento, pero no para el dolor y la distensión abdominal en pacientes con SII[16]. En esta misma revisión sistemática, la fibra soluble de los alimentos es la que proporcionó algún beneficio en los pacientes con SII.

Limitaciones. Aunque los alimentos ricos en fibra soluble pueden tener algún beneficio en el estreñimiento, no ocurre lo mismo con la fibra insoluble. En un metanálisis se analizaron 5 estudios, con un total de 221 pacientes. Se llegó a la conclusión de que no existen diferencias en la mejoría sintomática al comparar los que tomaban fibra insoluble frente a los que hacían una dieta baja en fibra o recibían placebo (riesgo relativo [RR] 1,02; 95% intervalo de confianza [IC] 95%: 0,82-1,27)[17]. Por otra parte, en casos de estreñimiento grave con importante enlentecimiento del tiempo de tránsito colónico (TTC), la dieta con alto contenido en fibra no es eficaz y puede empeorar el dolor y la distensión[9].

Recomendaciones prácticas. Una dieta con alimentos de alto contenido en fibra soluble (como las ciruelas secas), ha demostrado beneficio en la mejoría del estreñimiento leve pero no en la del dolor o la distensión abdominal, pudiendo incluso empeorar estos síntomas en pacientes con SII.

Utilidad de las distintas dietas en el síndrome del intestino irritable con estreñimiento y en el estreñimiento funcional para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión

Aproximadamente dos tercios de los pacientes con SII creen que sus síntomas son desencadenados por algún alimento.

En pacientes con SII se ha demostrado la existencia de sensibilidad al trigo en ausencia de enfermedad celiaca. En un ensayo clínico, se investigaron 920 pacientes con síntomas de SII y se evidenció que un tercio de los sujetos empeoró (aumento del dolor abdominal y la distensión) al ingerir trigo pero no placebo[18]. Sin embargo, está por determinar cuál es el papel de la sensibilidad al gluten no-celiaca, ya que en un estudio realizado en pacientes diagnosticados de esta entidad que cumplían criterios de SII, se comprobó que la administración de gluten en distintas concentraciones de forma aleatorizada y ciega frente a placebo no fue identificada por los pacientes[19].

Aunque la malabsorción de lactosa no juega un papel en el estreñimiento, sí se ha relacionado con el dolor y la distensión abdominal en pacientes con SII. En una revisión sistemática se analizaron los resultados de 7 estudios en los que se había realizado test de hidrógeno espirado con lactosa en pacientes con SII; el resultado fue que más de un tercio de los mismos tenían malabsorción de lactosa y que la intolerancia a la misma también era más común en los pacientes que en los controles[20]; sin embargo, es frecuente que los pacientes con SII presenten síntomas gastrointestinales tras la ingesta de productos lácteos aun cuando no se demuestra malabsorción de lactosa.

Por otra parte, una extensión de la hipótesis de la intolerancia a distintos hidratos de carbono en el SII ha llevado a plantear una dieta exenta de oligosacáridos, disacáridos, monosacáridos y polioles fermentables (FODMAP). En un estudio aleatorizado 41 pacientes con SII recibieron dieta baja en FODMAP o su dieta regular. El 68% de los pacientes que recibieron dieta baja en FODMAP refirió control adecuado de los síntomas con respecto al 23% que continuó con su dieta habitual (p = 0,005). La consistencia de las heces no se modificó en ambos grupos[21]. No obstante, en un estudio reciente, la dieta baja en FODMAP no fue superior al consejo dietético clásico en el SII[22].

Limitaciones. Como efectos secundarios de este tipo de dietas hay que señalar la posible malnutrición si se mantienen de forma prolongada.

Recomendaciones prácticas. El papel de algunos componentes de la dieta como desencadenantes de los síntomas o en la patogénesis del SII es objeto de interés creciente. La dieta sin gluten o la dieta baja en FODMAP parecen mejorar los síntomas de dolor y distensión abdominal en el SII pero no el estreñimiento. La dieta FODMAP no ha sido evaluada en pacientes con EF pero es muy poco probable que sea de utilidad. En definitiva, la evidencia actual es limitada para su recomendación rutinaria en la práctica clínica para el SII-E y el EF.

Utilidad de los suplementos de fibra para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión. ¿Qué tipo de fibra? ¿Cuál es la tolerabilidad?

Mecanismo de acción. Los suplementos de fibra en la dieta engloban un conjunto de hidratos de carbono complejos poco digeribles en el intestino delgado y que alcanzan íntegros el colon, contribuyendo a aumentar el volumen fecal y siendo parcialmente fermentados por la microbiota produciendo ácidos grasos de cadena corta, agua y gases (hidrógeno, metano, dióxido de carbono). Suele clasificarse en fibra soluble e insoluble, según su comportamiento en solución acuosa. Los efectos biológicos de la fibra son la aceleración del TTC, un aumento de la biomasa con cambios en el pH colónico y la microbiota y potencialmente tiene efectos sobre la permeabilidad y la inflamación[23].

Eficacia. Varios metanálisis han revisado la evidencia de la fibra sobre el EF y el SII. Todos ellos coinciden en la dificultad para extraer conclusiones conjuntas por la heterogeneidad de diseños y objetivos, y la baja calidad en general de los estudios. En conjunto, la fibra tiene un beneficio sobre los síntomas de estreñimiento (número de deposiciones, esfuerzo defecatorio) o sobre objetivos secundarios (uso de laxantes) superior al placebo, especialmente la fibra soluble (*psyllium*) tanto en estudios realizados en pacientes con EF como con SII. Los efectos sobre otros síntomas como el dolor o la distensión no están claros[24–26].

Efectos adversos. Los principales efectos adversos de la fibra dietética se derivan de su potencial para producir distensión, en general derivado de la producción de gases por la fermentación bacteriana. La mayoría de los ensayos clínicos no lo señalan como efecto adverso relevante, pero la práctica clínica muestra que esto puede ser importante, especialmente en pacientes en los que el estreñimiento se asocia con distensión abdominal y dolor[27].

Limitaciones. El uso de suplemento de fibra dietética no tiene grandes limitaciones clínicas; deben utilizarse con precaución y control clínico en pacientes inmovilizados o con trastornos graves conocidos de la motilidad intestinal y colónica, por un mayor riesgo de impactación.

Recomendaciones prácticas. La utilización de fibra dietética o suplemento de fibra como primera medida terapéutica es razonable en cualquier paciente con estreñimiento, asocie o no molestias abdominales, existiendo mayor evidencia con la fibra soluble, pudiendo considerarse que un curso de tratamiento de 6 semanas es suficiente para evaluar su eficacia[28]. Se debe prestar atención no solo a la eficacia sino también a la tolerancia, por lo que es aconsejable ir aumentando la cantidad de fibra de forma progresiva.

Utilidad de los laxantes osmóticos para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión. Efectos adversos y precauciones en situaciones especiales

Mecanismo de acción. Los laxantes osmóticos contienen iones no absorbibles o moléculas que retienen agua en la luz intestinal. Los más utilizados son el polietilenglicol (PEG), la lactulosa y las sales de magnesio.

Eficacia. Este tipo de laxantes mejoran el estreñimiento y la consistencia de las heces, pero se obtiene una pobre respuesta en el dolor y la distensión abdominal. La mayor evidencia, por los estudios disponibles, es para el PEG, pero las sales de magnesio se utilizan frecuentemente en la práctica clínica con resultado satisfactorio.

Solo dos ensayos clínicos han estudiado el uso de laxantes osmóticos (PEG) en SII-E. En el primero, no se observó superioridad con respecto al placebo[29]. En el segundo ensayo, se demostró mejoría en la frecuencia defecatoria pero no en el dolor o la distensión abdominal[30].

En cuanto a los estudios específicos para el EF, en 5 ensayos se evaluó el PEG frente a placebo. Se demostró la superioridad del PEG con un número necesario de pacientes a tratar (NNT) de 3 (IC 95%: 2- 4). La lactulosa también fue superior al placebo con un NNT de 4 (IC 95%: 2-7)[31].

En otra revisión sistemática en la que se comparan PEG y lactulosa, el PEG fue superior en los resultados: número de deposiciones a la semana, consistencia de las heces, alivio del dolor abdominal y necesidad de otros fármacos[32].

Efectos adversos. Los efectos secundarios más frecuentes son dolor y distensión abdominal, diarrea, náuseas y vómitos. Se han descrito muy pocos casos de reacciones de hipersensibilidad (erupción, urticaria o edema). Tienen buen

perfil de seguridad y se pueden utilizar en pacientes ancianos, mujeres embarazadas y durante la lactancia. También se pueden utilizar en caso de insuficiencia hepática o renal. El PEG tiene menos efectos secundarios que la lactulosa y su administración es segura durante periodos prolongados (hasta 6 meses). En el caso de las sales de magnesio, el efecto secundario más común es el desequilibrio electrolítico; por ello, se debe utilizar con precaución en pacientes con insuficiencia renal por el riesgo de hipermagnesemia[11].

Limitaciones. La principal limitación de este grupo de laxantes es su escasa respuesta para el control del dolor y la distensión abdominal, síntomas importantes, sobre todo en pacientes con SII. El PEG parece algo superior a la lactulosa en este sentido y por ello, esta última no es recomendable en pacientes con SII-E[33].

Recomendaciones prácticas. Los laxantes osmóticos son útiles para el tratamiento del estreñimiento pero no para el control del dolor y la distensión abdominal, por lo que son fármacos de primera línea en el EF pero su utilidad es más limitada en el SII-E. El PEG es más eficaz que la lactulosa en el control de los síntomas y produce menos efectos secundarios, por lo que debe considerarse como fármaco de primera elección. Tienen un buen perfil de seguridad, por lo que se pueden utilizar en situaciones específicas, como en ancianos, durante el embarazo y en pacientes con insuficiencia renal y hepática.

Utilidad de los laxantes estimulantes para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión. Efectos adversos y precauciones en situaciones especiales

Mecanismo de acción. Estos fármacos favorecen la secreción de agua y electrólitos en el colon o inducen la peristalsis del mismo. Entre los laxantes estimulantes se incluyen los difenilmetanos (fenolftaleína, bisacodilo, picosulfato sódico) y las antraquinonas (*Senna*, cáscara sagrada, *aloe vera*).

Eficacia. En dos ensayos clínicos se estudió la eficacia del bisacodilo y del picosulfato sódico. En el primero se incluyeron 247 pacientes a los que se trató con 10 mg de bisacodilo, frente a 121 pacientes que recibieron placebo una vez al día durante 4 semanas. El bisacodilo fue superior al placebo para mejorar el estreñimiento, otros síntomas asociados al mismo y mejorar la calidad de vida[34]. En el segundo ensayo se evaluó la eficacia del picosulfato sódico frente a placebo, de forma que 131 pacientes recibieron 10 mg de picosulfato sódico y 71 placebo durante 4 semanas. Como en el caso anterior, el picosulfato sódico fue superior al placebo para mejorar el estreñimiento[35]. Considerando ambos estudios en conjunto, en el 42,1% de los pacientes que recibieron laxantes estimulantes fracasó el tratamiento frente al 78% de los que recibieron placebo, con un NNT de 3 (IC 95%: 2-3,5)[31].

Efectos adversos. Los efectos adversos más frecuentes son dolor abdominal, diarrea, náuseas y vómitos. Con menor frecuencia se han descrito reacciones alérgicas. Los tratamientos prolongados pueden provocar pérdida de líquidos y electrólitos, por lo que se deben utilizar con mucha precaución en ancianos, pacientes con insuficiencia cardiaca o en pacientes con tratamiento diurético o con corticoides. No se dispone de suficientes estudios para poder garantizar su seguridad durante el embarazo, por lo que no se recomiendan en esta situación.

Limitaciones. Como ocurre con los laxantes osmóticos, estos fármacos no han demostrado su eficacia en el control del dolor y la distensión abdominal, e incluso pueden empeorar estos síntomas. Por otra parte, en muchos casos los pacientes no pueden conseguir un ritmo intestinal «predecible».

Recomendaciones prácticas. Los laxantes estimulantes son útiles para el tratamiento del estreñimiento, aunque menos eficaces para controlar el dolor y la distensión abdominal, por lo que su utilidad es muy limitada en el SII-E. Su perfil de seguridad es menor que el de los laxantes osmóticos.

Utilidad de los probióticos para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión

Mecanismo de acción. Los probióticos son bacterias vivas que poseen diversas características como son la supervivencia en el tracto gastrointestinal, la adherencia al epitelio intestinal y la modulación de la flora intestinal, inhibiendo las bacterias potencialmente patógenas y produciendo diversos efectos inmunomoduladores e inmunoestimulantes, como el estímulo para la proliferación de células inmunitarias, el aumento en la actividad de las células fagocíticas o el incremento en la producción de IgA. Todo ello, determina su potencial efecto beneficioso en la prevención de infecciones, especialmente por patógenos de origen intestinal, y de la translocación bacteriana[36–38].

Eficacia. En base a las revisiones sistemáticas y metanálisis existentes al respecto, el uso de los probióticos para el alivio de los síntomas globales (mejoría de la defecación, de la hinchazón abdominal y el dolor abdominal) de los pacientes con SII, es todavía incierto, existiendo por una parte estudios que arrojan resultados positivos a su uso, como otros que no encuentran diferencias significativas.

Respecto al EF, los datos son más inciertos todavía, dada la heterogeneidad entre los diversos estudios y sesgos existentes en los mismos[31,39–41].

Efectos adversos. En ningún estudio se aprecian efectos secundarios respecto del uso de probióticos en este tipo de pacientes.

Limitaciones. No se encuentran actualmente limitaciones al uso de probióticos en ningún estudio.

Recomendaciones prácticas. Dada la falta de evidencia actual a favor por los resultados contradictorios que arrojan los diversos estudios respecto de su eficacia en el alivio de los síntomas de dolor abdominal, distensión y mejora en el ritmo deposicional en los pacientes con SII-E y EF, no podemos recomendar hoy por hoy su uso en estos pacientes.

Utilidad de los antibióticos para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión

Mecanismo de acción. La rifaximina es un antibiótico sintético derivado de la rifamicina, con actividad grampositiva, gramnegativa y frente a microorganismos aerobios y

anaerobios, no absorbible a través de la mucosa intestinal (<0,01% tras la administración oral) por lo que actúa intraluminalmente, con nulo efecto sistémico. Impide la adherencia de los patógenos a la mucosa intestinal y la invasión de las células epiteliales por estos, al unirse a la subunidad β de la ácido ribonucleico polimerasa microbiana, inhibiendo de este modo la transcripción y la síntesis de ácido ribonucleico[42].

Eficacia. El uso de rifaximina parece reducir según las revisiones de los estudios llevados a cabo, los síntomas de distensión, flatulencia y dolor abdominal en los pacientes con SII sin estreñimiento[31,42–44]. En un estudio se señala que pudiera ser útil en el subgrupo de pacientes de SII-E[45].

No hay actualmente, estudios que evalúen sus efectos en el EF.

Limitaciones. Efectos adversos y contraindicaciones. No se reflejan en los distintos estudios y revisiones, efectos secundarios mayores o más frecuentes que los comparados con placebo[46–48].

Recomendaciones prácticas. No existen suficientes datos actualmente para recomendar la utilización de rifaximina en pacientes con EF o SII-E, aunque podría disminuir la hinchazón y la flatulencia.

Utilidad de los espasmolíticos para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión. Efectos adversos y precauciones en situaciones especiales

Mecanismo de acción. Los espasmolíticos se han utilizado clásicamente en el tratamiento empírico del SII basándose en que la contracción espástica del músculo liso colónico contribuye a los síntomas del SII, especialmente al dolor. Se distinguen 3 clases principales: antagonistas de canales del calcio (otilonio y pinaverium), relajantes directos del músculo liso (mebeverina) y anticolinérgicos/antimuscarínicos (hioscina, cimetropium, hidrocloruro de diciclomina).

Eficacia. Los espasmolíticos son superiores al placebo en la mejoría de los síntomas en el SII, sobre todo el dolor y la distensión abdominal (38% en el grupo placebo y 56% en el grupo tratado con espasmolíticos; *odds ratio* [OR]: 2,13 [IC 95%: 1,77-2,58])[49]. El efecto de los distintos espasmolíticos de forma individual es variable y difícil de interpretar, ya que solo hay un reducido número de estudios que evalúen cada uno de los 12 diferentes fármacos disponibles. De todos ellos, el bromuro de otilonio (5 ensayos) y la hioscina (3 ensayos) mostraron evidencia de eficacia[17]. El bromuro de cimetropium, de pinaverium y el hidrocloruro de diciclomina también han demostrado cierto grado de beneficio[31]. En cualquier caso, hay que tener en cuenta la heterogeneidad de los estudios. Otros espasmolíticos estudiados no fueron superiores al placebo.

En otro ensayo clínico multicéntrico se demostró además que los pacientes tratados con bromuro de otilonio tuvieron menos probabilidad de recurrencias de los síntomas que los tratados con placebo[50].

Efectos adversos. El 14% de los pacientes tratados con espasmolíticos refirieron efectos secundarios, frente al 9% de los tratados con placebo. Los efectos secundarios más frecuentes fueron sequedad bucal, mareo y visión borrosa y no hubo ningún efecto adverso grave. El RR de presentar un efecto adverso frente a placebo fue 1,61 (IC 95%: 1,08-2,39)[17,31].

Los espasmolíticos con más acción anticolinérgica pueden provocar alteraciones visuales, retención urinaria, estreñimiento y sequedad de boca. Se deben administrar con precaución en pacientes ancianos, con antecedentes de infarto agudo de miocardio e hipertensión. No se recomienda su utilización en el embarazo y en la lactancia, ya que su seguridad en estas situaciones no ha sido establecida.

Limitaciones. Los espasmolíticos son útiles en el control del dolor y la distensión abdominal pero no tienen acción sobre el estreñimiento.

Recomendaciones prácticas. Los espasmolíticos son eficaces en el tratamiento del dolor y la distensión abdominal en pacientes con SII con buen perfil de seguridad. Los efectos secundarios de estos fármacos son poco frecuentes; no obstante, los que tienen mayor acción anticolinérgica pueden tener efectos adversos a dosis altas.

Utilidad de la esencia de menta para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión. Efectos adversos

Mecanismo de acción. La esencia de menta, con frecuencia también llamado aceite, tiene propiedades espasmolíticas y en la modulación del dolor al atenuar la hipersensibilidad visceral.

Eficacia. En dos revisiones sistemáticas se demuestra un efecto superior al placebo en el control del dolor en pacientes con SII[17,31]. En la más reciente se incluyeron 5 ensayos con un total de 482 pacientes[51–55]; se demostró un efecto positivo estadísticamente significativo a favor de la esencia de menta frente a placebo, con un NNT de 3 (IC 95%: 2-4)[31]. Sin embargo, había heterogeneidad significativa entre los estudios.

Efectos adversos. En los estudios señalados no se describieron efectos secundarios significativos con respecto al placebo. La esencia de menta no suele tener efectos adversos a dosis convencionales, pero se han descrito reacciones alérgicas, pirosis y cefalea. No se conoce su perfil de seguridad a las dosis que se utilizan para el tratamiento en SII en el caso de embarazo y lactancia, por lo que no se recomienda su utilización en estas situaciones.

Limitaciones. Como ocurre con otros espasmolíticos, no tiene acción demostrada sobre el estreñimiento.

Recomendaciones prácticas. La esencia de menta ha demostrado ser eficaz para el control del dolor y la distensión en pacientes con SII con escasos efectos adversos.

Utilidad de la prucaloprida para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión. Efectos adversos y precauciones en situaciones especiales

Mecanismo de acción. La serotonina (5-HT) juega un papel crucial en el tracto gastrointestinal influyendo en las funciones secretora, motora y sensorial. Existen 7 subtipos de receptores de 5-HT a nivel intestinal. De ellos, el receptor 5-HT_4 favorece la secreción intestinal, aumenta el peristaltismo y el tránsito intestinal[56]. Prucaloprida es un agonista

altamente selectivo del receptor 5-HT_4 y que por tanto, actúa estimulando la motilidad intestinal[57].

Eficacia. En los ensayos fase III prucaloprida fue superior al placebo en mejorar el estreñimiento, el dolor y la distensión abdominal así como la calidad de vida[58–60].

En una revisión sistemática en la que se incluyeron 8 ensayos clínicos, la respuesta de prucaloprida para mejorar el estreñimiento fue superior a la obtenida con placebo (fracaso del tratamiento en 71% de los pacientes con prucaloprida y en 87,4% con placebo), aunque se identificó importante heterogeneidad en los estudios[31].

En otro metanálisis, en el que se incluyeron 9 ensayos, también se demostró la eficacia de prucaloprida en el estreñimiento consiguiendo una media de al menos 3 deposiciones a la semana (RR=1,63; IC 95%: 1,07-2,49). Además, mejoraron tanto la calidad de vida (RR=1,51; IC 95%: 1,07-2,11) como la consistencia de las heces (diferencia media frente al grupo control 9,16; IC 95%: 7,28-11,03)[61]. También parece ser un fármaco útil para el estreñimiento refractario en el anciano según los resultados obtenidos en un ensayo clínico fase II[62].

Por otra parte, hay que reseñar su potencial utilidad, aunque no hay suficiente evidencia al respecto, en otros trastornos de la motilidad que cursan con estreñimiento, como la seudoobstrucción intestinal crónica. Prucaloprida mejoró los síntomas de distensión y dolor abdominal en pacientes con esta patología[63].

Se necesitan estudios para verificar la asociación de prucaloprida con otros fármacos, como linaclotida o lubiprostona, para los casos de estreñimiento grave.

Efectos secundarios. La seguridad y tolerancia del fármaco es buena. Los efectos secundarios más frecuentes son dolor de cabeza, náuseas, dolor abdominal y diarrea. El perfil de seguridad cardiaco es muy bueno debido a su afinidad selectiva por los receptores 5-HT_4 intestinales. No obstante, se debe utilizar con precaución en la insuficiencia renal avanzada y en la insuficiencia hepática grave. No se recomienda la utilización de prucaloprida durante el embarazo (fármaco de clase C) ni durante la lactancia.

Limitaciones. El fármaco no ha sido comercializado en España con la indicación de SII-E aunque por lo señalado anteriormente, podría tener un papel en los casos de SII-E grave y sin respuesta a otros tratamientos.

Recomendaciones prácticas. Prucaloprida es un fármaco útil en el tratamiento del EF sin respuesta a otras medidas farmacológicas; en menor medida, también mejora el dolor y la distensión en estos pacientes con un buen perfil de seguridad. Se puede utilizar en pacientes ancianos con estreñimiento refractario, con la recomendación de reducir la dosis a la mitad (1 mg).

Utilidad de la linaclotida para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión. Efectos adversos y precauciones en situaciones especiales

Mecanismo de acción. La linaclotida es una agonista de la guanilato ciclasa C, cuyo estímulo produce un aumento del guanosín monofostafo cíclico intracelular en el enterocito. Este guanosín monofostafo cíclico actúa a nivel intracelular produciendo un aumento de la secreción de bicarbonato y cloro hacia la luz intestinal y se difunde al espacio extracelular ejerciendo una acción sobre las terminaciones sensitivas, disminuyendo su actividad. Desde el punto de vista farmacodinámico, el efecto final es un aumento de la secreción intraluminal con la consiguiente aceleración del tránsito y un efecto analgésico visceral, con disminución de umbrales sensitivos a la distensión mecánica[64,65].

Eficacia. Tomando como base los ensayos clínicos y metanálisis comparativos de linaclotida frente a placebo[66,67] tanto en pacientes con SSI-E (RR: 1,95 con IC 95%: 1,3-2,9, basado en 7 estudios) como en pacientes con EF (RR 4,26 con IC 95% 2,80-6,47, basado en 3 estudios), linaclotida es claramente eficaz para aliviar los síntomas de estreñimiento con NNT 7 (IC 95% 5–11)[66]en ambos grupos de pacientes, mostrando unos resultados muy homogéneos a lo largo de todos los estudios. Los efectos de linaclotida no se limitan solo a su acción sobre los síntomas de estreñimiento sino que en ambos grupos (EF, SII-E) se muestra en los ensayos clínicos una mejoría del dolor y la distensión (un beneficio entre un 15-30% sobre el placebo).

Efectos adversos. Desde el punto de vista práctico, el único efecto adverso registrado relevante es la diarrea, cuya importancia ha de ser evaluada con el paciente. De hecho, en los ensayos clínicos se reporta diarrea en aproximadamente un 20% de los pacientes tratados con linaclotida, pero solo un 2% es catalogada como grave y solo motivó la retirada del fármaco en el 4,5% de los pacientes tratados.

Limitaciones. La linaclotida no se absorbe y no pasa a la circulación sistémica, ni actúa sobre el citocromo P450; por ello, aunque no se ha estudiado específicamente en pacientes con insuficiencia hepática o renal, no cabe pensar que exista ninguna limitación para su uso en este tipo de pacientes. Su eficacia y seguridad es similar tanto en el anciano como en el adulto de mediana edad. No existen datos respecto a la posibilidad de efectos teratogénicos, aunque son improbables, y por ello no se aconseja su utilización en el embarazo. El fármaco está comercializado en España para la indicación de SII-E, no para el EF. En otros países europeos o en EE. UU., donde se indica en EF, se utiliza a mitad de dosis.

Recomendaciones prácticas. La linaclotida es el fármaco de elección en pacientes con estreñimiento y molestias abdominales, como dolor y distensión cuando la fibra dietética y los laxantes han fracasado[66,67].

Utilidad de la lubiprostona para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión. Efectos adversos y precauciones en situaciones especiales

Mecanismo de acción. La lubiprostona es un derivado prostaglandínico que activa los canales del cloro tipo 2 (CIC-2) de la membrana luminal del enterocito, produciendo un aumento de la secreción de cloro hacia la luz intestinal, lo que conlleva un aumento del tránsito intestinal. No se han demostrado efectos sobre la sensibilidad visceral.

Eficacia. La lubiprostona ha mostrado su eficacia para mejorar los síntomas de estreñimiento NNT 4 (IC 95% 3-7)[68]. En ensayos clínicos en pacientes con síndrome de intestino irritable ha mostrado un cierto efecto sobre el

dolor (aproximadamente un 7% de ventaja sobre el placebo) que aparece al mes de tratamiento[68,69].

Efectos adversos. Los principales efectos adversos son la diarrea y las náuseas, ocurriendo estas últimas hasta en un 15% de los pacientes que reciben tratamiento activo. Aunque raro, se ha descrito disnea en relación con lubiprostona.

La lubiprostona no requiere ajuste en pacientes con insuficiencia renal; aunque no existe evidencia de metabolización hepática, la FDA recomienda reducir la dosis en paciente con hepatopatía con un grado B o C de Child-Pugh. Está contraindicado su uso durante el embarazo, encontrándose clasificada en la categoría C.

Recomendaciones prácticas. La lubiprostona no se encuentra comercializada en Europa.

Utilidad del *biofeedback* anorrectal para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión

Mecanismo de acción. El *biofeedback (BFB)* anorrectal es una técnica de reeducación indicada en pacientes con disinergia defecatoria en la que se monitoriza la actividad fisiológica anal y rectal y se muestran las alteraciones al paciente enseñando las maniobras adecuadas para corregirlas.

Eficacia. Los estudios comparando el BFB con el BFB ficticio, tratamiento estándar, laxantes o diazepan[70,71], muestran una superioridad del BFB sobre todos ellos, de una magnitud variable, para mejorar los síntomas de estreñimiento. Tan solo un estudio evalúa su efecto sobre el dolor abdominal, observando un beneficio significativo comparado con laxantes. Ningún estudio evalúa su efecto sobre la distensión abdominal.

Efectos adversos. No se han descrito. No existen a priori limitaciones para la aplicación del BFB por las características del paciente, aunque se requiere una adecuada disponibilidad y capacidad para seguir las instrucciones y completar la reeducación.

Recomendación práctica. El *BFB* es la técnica de elección en pacientes con estreñimiento y disinergia pélvica demostrada[72].

Utilidad de los antidepresivos para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión. Efectos adversos y precauciones en situaciones especiales

Mecanismo de acción. Las vías por las que estos fármacos ejercen sus efectos beneficiosos, varían dependiendo de qué familia de fármacos utilicemos.

Los *antidepresivos tricíclicos (ADT)* (amitriptilina). Logran sus efectos, mediante la capacidad de modulación de la percepción del dolor a nivel central[73].

Los *inhibidores de la recaptación de la serotonina (ISRS)* (fluoxetina, paroxetina, citalopram, escitalopram): Disminuyen la sensibilidad visceral, mejoran la sensación de bienestar global, poseen propiedades ansiolíticas y potencian los efectos de otros fármacos como los ADT[73,74].

Los *inhibidores de la recaptación de la serotonina y noradrenalina (ISRSN)* (duloxetina, venlafaxina, desvenlafaxina): mejoran el control del dolor mediante el bloqueo dual de los receptores de serotonina y noradrenalina[75].

Eficacia

Sobre la eficacia de los ADT y los ISRS, hay resultados dispares dependiendo del fármaco estudiado. En un metanálisis[73], el uso de ADT o ISRS, mejoraron de forma global los síntomas de distensión, dolor abdominal y también la consistencia de las heces en pacientes con SII con una NNT de 4 para ambas terapias (IC 95% 3-6; 4 para ADT con IC 95% 3-8 y 3,5 para ISRS con IC 95%2-14). Sin embargo, en el SII-E no debe utilizarse los ADT por aumentar el estreñimiento.

Por otra parte, en otro estudio[74] donde se analizó la terapia durante 16 semanas con fluoxetina (ISRS), se concluye que fluoxetina, a dosis inferiores a las que se utilizan en el tratamiento para las distintas psicopatologías, mejoró de forma global todos los síntomas asociados de SII-E (dolor, distensión abdominal y consistencia de las heces). El análisis con paroxetina frente a placebo, doble ciego y randomizado, no encontró diferencias significativas en la variable principal (dolor abdominal), pero sí en las de memoria global y severidad de los síntomas[76]. También hay estudios a favor de citalopram en este aspecto[75].

Respecto de los ISRSN, solo duloxetina a dosis de 60 mg/día ha sido estudiada en pacientes con SII[77], mejorando los síntomas de dolor y consistencia de las deposiciones.

Limitaciones. Efectos adversos[78]

ADT. Son lo que tienen un mayor número de efectos secundarios derivados de los múltiples mecanismos de acción (sequedad de boca, estreñimiento, náuseas, vómitos, hipotensión ortostática, etc.). Debido a que favorecen marcadamente el estreñimiento no deben utilizarse en SII-E (ni, obviamente, en EF). Precaución en enfermos cardiacos, neurológicos, urológicos e insuficiencia hepática entre otros.

ISRS. Mejor tolerados que los ADT. Suelen ser leves, pero molestos y en ocasiones obligan a la retirada del fármaco. Entre ellos están la sequedad oral y el adormecimiento, disminución de la libido, anorgasmia, alteraciones gastrointestinales (sensación nauseosa, diarreas o estreñimiento) y ganancia ponderal.

ISRSN. También mejor tolerados que los ADT. Pueden provocar náuseas, somnolencia, mareos, diarrea, fatiga, estreñimiento, hiperhidrosis, boca seca, vómitos, disminución del apetito, astenia y anorexia.

Recomendaciones prácticas. El uso de antidepresivos, a dosis inferiores a las usadas para las alteraciones psiquiátricas, puede estar indicado en el tratamiento de los síntomas persistentes de distensión y dolor abdominal y mejora de la consistencia de las heces en el SII-E. Los antidepresivos recomendados en el SII-E son los ISRS, evitando los ADT. Debería reservarse su uso a pacientes con persistencia de estos síntomas tras otros tratamientos (medidas higiénico-dietéticas, laxantes y linaclotida), así como a aquellos con una psicopatología asociada que indique su uso. Cuando clínicamente sean eficaces, se recomienda prolongar el tratamiento al menos 6 meses.

No hay datos suficientes actualmente, para hacer esta recomendación en los casos de EF, salvo en la existencia de comorbilidad psiquiátrica que tenga indicado su uso.

Utilidad de los tratamientos psicológicos en pacientes con SII para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión. Efectos adversos y precauciones en situaciones especiales

Mecanismo de acción. Diversos estudios han señalado la asociación entre el estrés psicológico y el empeoramiento de los síntomas gastrointestinales en pacientes con SII[79–82]. No tienen lugar en tratamiento de EF. Los tratamientos psicológicos pueden disminuir el nivel de estrés, modificar el umbral perceptivo visceral y en consecuencia, conseguir mejorar la clínica de los pacientes[3] en cuanto a la mejora del dolor y del hábito intestinal.

Eficacia. En una revisión sistemática sobre los tratamientos psicológicos, en la que se incluyeron 2.189 pacientes, se observó un efecto estadísticamente significativo a favor de las terapias psicológicas, con un NNT de 4 (IC 95%: 3-5); no obstante, se observó importante heterogeneidad en los estudios y la calidad de los mismos es limitada[31]. Por otra parte, por el tipo de intervención no fue posible seleccionar estudios doble ciego. Con respecto a los 10 diferentes tipos de terapias, las que han demostrado beneficio han sido la terapia cognitiva-conductual, la hipnoterapia, el tratamiento psicológico multicomponente presencial y vía telefónica y la psicoterapia dinámica[31].

La hipnosis puede modificar el umbral perceptivo visceral y conseguir una mejoría clínica a corto y largo plazo[83,84].

Efectos secundarios. No se han descrito.

Limitaciones. Este tipo de terapias requiere la colaboración del paciente, así como dedicación y tiempo por parte del terapeuta y del paciente. Además, son tratamientos caros y poco accesibles.

Recomendaciones prácticas. Algunos tipos de tratamientos psicológicos, como la terapia cognitivo-conductual y la hipnosis, pueden ser útiles para controlar el dolor abdominal, además de disminuir el nivel de estrés en pacientes con SII.

Utilidad de la acupuntura en pacientes con SII para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión. Efectos adversos

Mecanismo de acción. La acupuntura se basa en el efecto de la estimulación de determinadas zonas o «puntos gatillo» repartidas por todo el cuerpo, que tienen relación con las distintas vísceras y otras partes del organismo (articulaciones, paquetes musculoesqueléticos, etc.) a través de la inserción superficial en la piel, de finas agujas. A este respecto, determinados puntos de estimulación, se relacionan con el dolor abdominal, la diarrea y el estreñimiento, pudiendo actuar sobre estos síntomas tratando de estimular los puntos necesarios mediante esta técnica[85].

Eficacia. En un metanálisis en el que se incluyeron 17 estudios controlados y randomizados sobre los probables beneficios de la acupuntura en la mejoría de los síntomas globales y la calidad de vida de pacientes con SII, no se pudieron hallar datos favorables al respecto[86].

Otro estudio que evaluó el tratamiento con acupuntura y sus efectos a nivel de mejora global de síntomas como variable principal y como variables secundarias la mejora en la calidad de vida, y en los diversos síntomas por separado, tampoco encontró diferencias a favor de dicha terapia[87].

Respecto del probable efecto sobre los síntomas en EF no hay, hoy por hoy, estudios al respecto.

Limitaciones. No se han descrito limitaciones en este tipo de terapia.

Recomendaciones prácticas. No hay evidencia disponible que permita recomendar la acupuntura para mejorar los síntomas y la calidad de vida de los pacientes con SII-E o EF.

Utilidad de los supositorios y los enemas como medicación de rescate para mejorar el estreñimiento. Efectos adversos y precauciones en situaciones especiales

Los enemas y supositorios son esenciales en el tratamiento del estreñimiento complicado con impactación fecal, en algunos casos de defecación obstructiva y como complemento de otras medidas terapéuticas en casos de estreñimiento grave con importante alteración del tránsito intestinal para conseguir la limpieza del colon distal.

Mecanismo de acción. Existen diferentes tipos de enemas y supositorios. Todos ellos, producen distensión rectal favoreciendo la defecación. Dependiendo del tipo de enema, pueden existir mecanismos de acción adicionales, por ejemplo, los enemas salinos hacen que el agua drene hacia el colon, los de fosfato estimulan la motilidad colónica y los de aceite mineral o emolientes lubrican y ablandan las heces duras. Como ocurre con los enemas, dependiendo del tipo de supositorios varía su mecanismo de acción. Existen supositorios con efecto estimulante, como los que contienen bisacodilo. Otros, como los supositorios de glicerina, tienen acción local. El efecto mecánico para la inserción del supositorio, puede por sí mismo estimular la defecación.

Eficacia. La evidencia científica respecto al tipo de enema que se debe utilizar es escasa, aunque la utilización de agua templada, suero salino (fisioenema) o algún tipo de sustancia osmótica suele ser lo más frecuente[88].

En el caso de pacientes con disfunción neurogénica intestinal secundaria a lesión medular se ha utilizado con éxito el sistema de irrigación anal con Peristeen® mediante el cual se introducen unos 750 mL de agua templada en el colon. En un estudio aleatorizado se consiguió reducir el número de procedimientos necesarios para conseguir la limpieza intestinal, además de mejorar la incontinencia y la calidad de vida de los pacientes con respecto al tratamiento conservador[89]. Estos alentadores resultados se han confirmado posteriormente en un estudio multicéntrico italiano, que concluye que se puede considerar el tratamiento de elección en este tipo de pacientes[90]. Además esta terapia es coste-efectiva con respecto al tratamiento conservador[90,91].

Otros enemas frecuentemente utilizados son los de fosfato de sodio de 250 mL que tienen un efecto osmótico y también los enemas de suero salino (fisioenema), que no tienen efectos secundarios ni requieren receta médica, como

sí ocurre con los enemas de fostatos, cuyos efectos secundarios se señalan en el siguiente apartado.

En el caso de los supositorios, como se ha señalado anteriormente, hay que diferenciar los que actúan localmente, de forma tópica, para favorecer el vaciado de la ampolla rectal, de los supositorios activos, como por ejemplo los de bisacodilo, que se tratan en el apartado de los laxantes estimulantes.

Efectos secundarios. No se han descrito efectos secundarios importantes de la irrigación de agua con el sistema Peristeen®.

En el caso de los enemas de fosfato, su utilización prolongada puede ocasionar desequilibrios hidroelectrolíticos, como hiperfosfatemia, hipocalcemia e hipernatremia. Por ello, se deben utilizar con precaución en caso de alteraciones electrolíticas previas, como en la insuficiencia renal grave, en pacientes ancianos, en caso de hipertensión no controlada y en la insuficiencia cardiaca. El abuso en la aplicación de enemas también puede provocar fibrosis y estenosis anorrectal por microtrauma de repetición[92].

Los efectos adversos más frecuentes de los supositorios son irritación, escozor o picor anal. Debido al tipo de medicamento del que se trata y a su vía de administración, no afecta al uso concomitante de otros fármacos.

Limitaciones. En algunos casos, la correcta aplicación de los supositorios o enemas puede ser difícil en pacientes con problemas de movilidad, como ocurre en los casos de lesión medular. Sin embargo, esta dificultad parece ser menor con la utilización del sistema Peristeen®.

Recomendaciones prácticas. Los enemas son útiles en el caso de estreñimiento complicado con impactación fecal y como medida de rescate asociada a otros tratamientos en casos de estreñimiento grave, aunque no hay evidencia científica al respecto. Sí que hay evidencia de la utilidad de la irrigación transanal de agua con el sistema Peristeen® en pacientes con lesión medular y probablemente pueda tener cierta eficacia en otros casos de estreñimiento grave.

Utilidad de la neuroestimulacón de raíces sacras para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión. Efectos adversos y precauciones en situaciones especiales

Mecanismo de acción. Consiste en la estimulación de las raíces sacras S3-S4 mediante electrodos implantados, inicialmente de forma temporal durante unas 4 semanas y posteriormente, si se muestra eficaz, implantados de forma permanente. El mecanismo de acción no está claro pero parece mejorar la sensibilidad rectal y la contractilidad colónica, mejorando el TTC.

Eficacia. Los estudios publicados respecto a la eficacia de la neuroestimulación de raíces sacras se centran en pacientes con estreñimiento por tránsito lento refractarios a todo tipo de tratamiento y se carece de estudios controlados, evaluándose la eficacia mediante diseños cruzados. Un metanálisis de la *Cochrane Database of Systematic Reviews* de 2007 señala un aumento del número de deposiciones de 2 a 5 semanales y una mejoría del dolor y la distensión abdominal[93]. El estudio más relevante es un estudio multicéntrico europeo con 62 pacientes; se implanta el dispositivo de forma permanente al 73%, obteniéndose una mejoría sostenida en un seguimiento a 28 meses de los síntomas de estreñimiento, dolor y distensión abdominal. No obstante, persisten las dudas respecto al beneficio a más largo plazo[94].

Efectos adversos. El procedimiento no está exento de efectos adversos. En el estudio multicéntrico[94] se registran 11 efectos adversos graves relacionados con el tratamiento, fundamentalmente por infección, dolor postimplantación, erosión mecánica de tejidos y migración del electrodo.

Entre las precauciones especiales cabe señalar la recomendación de detener la estimulación si ocurre un embarazo. No existe información respecto a su seguridad en pacientes con comorbilidades importantes.

Recomendación práctica. La utilidad de la neuroestimulación de raíces sacras es discutida, por lo que debería considerarse una opción únicamente en pacientes con EF intratable por TCL, en los que se ha descartado una disinergia defecatoria.

Utilidad de la cirugía para mejorar: a) el estreñimiento, b) el dolor abdominal, c) la distensión. Efectos adversos y precauciones en situaciones especiales

Mecanismo de acción. La cirugía se ha propuesto para el tratamiento del estreñimiento con TCL grave mediante técnicas resectivas (colectomía), siendo el mecanismo de acción una disminución de la capacidad reabsortiva del agua del material fecal.

Eficacia. No existen estudios controlados de cirugía en el EF y la eficacia debe extrapolarse de la revisión de series de casos[95]. En este análisis de 2011, de 48 estudios con 1.443 pacientes, el 65% mejoró la frecuencia defecatoria y un 88% no requirieron laxantes posteriormente. Su eficacia sobre la distensión abdominal y el dolor no es conocida.

Efectos adversos. De acuerdo con la revisión de series de casos[95], la mortalidad se sitúa en el 0,2%. Además de las complicaciones inmediatas (íleo: 0-16%, infección: 0-13%, dehiscencia de anastomosis: 0-22%), se deben considerar importantes complicaciones tardías (obstrucción: 0-74%, incontinencia 0-53%).

Recomendación práctica. La cirugía debe reservarse para casos excepcionales de estreñimiento en los que se ha demostrado un TCL descartando seudoobstrucción intestinal y disinergia defecatoria y tras una evaluación psicológica adecuada. Estos pacientes deben ser atendidos en centros especializados.

Coordinación entre niveles asistenciales

Para acceder al apartado de *Coordinación entre niveles asistenciales* (pregunta 35 y tabla 7 de la Parte 1), ver las publicaciones correspondientes[96–98].

Conflicto de intereses

Los autores firmantes de esta GPC lo hacen en nombre de la SEPD, la semFYC, la SEMERGEN, la SEMG o como socios de la Asociación Española de Gastroenterología (AEG). Ni estas sociedades científicas ni ninguno de los integrantes del grupo de trabajo tienen vinculación alguna con las compañías que

desarrollan los fármacos para las patologías abordadas en esta GPC. La SEPD, la semFYC, la SEMERGEN y la SEMG, así como los componentes del grupo pertenecientes a las mismas, no tienen intereses económicos en las compañías que han realizado la investigación y distribuyen medicamentos para estas patologías del aparato digestivo, si bien mantienen, tanto sociedades como integrantes del grupo, una sostenida relación con las mismas en la promoción de formación, investigación y mejora de la práctica clínica hacia la promoción de la salud digestiva. Finalmente, la SEPD, la semFYC, la SEMERGEN y la SEMG, así como los autores firmantes declaran que este trabajo ha recibido financiación de Almirall y Allergan, que ha carecido de cualquier tipo de influencia externa en el mismo y que ninguna tercera parte ha participado en la deliberación ni desarrollo del mismo ni ha conocido el contenido del texto final, antes de su publicación efectiva en la Revista Española de Enfermedades Digestivas y resto de órganos de expresión de cada sociedad participante.

Agradecimientos

Los autores agradecen la colaboración de los responsables de las cuatro Sociedades Científicas de las que forman parte, así como el trabajo de apoyo de Marién Castillo Sánchez, de Joaquín León Molina en la gestión bibliográfica y de José María Tenías en el soporte metodológico. También agradecen especialmente las sugerencias y comentarios de los siguientes revisores externos: Agustín Balboa Rodríguez, R. Manuel Devesa Muñiz, Higinio Flores Tirado, Juan Manuel Mendive Arbeloa, Xavier Puigdengolas Armengol, Mercedes Ricote Belinchón, Cecilio Santander Vaquero, Jordi Serra Pueyo, Carlos A. Siljeström Laredo y María José Soria de la Cruz.

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Clinical and Experimental Gastroenterology

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ORIGINAL RESEARCH

The burden of irritable bowel syndrome and chronic constipation on health-related quality of life in black Africans: a comparison with healthy control subjects in Côte d'Ivoire, West Africa

This article was published in the following Dove Press journal:
Clinical and Experimental Gastroenterology

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Background: Although patients with irritable bowel syndrome (IBS) and chronic constipation (CC) have an impaired health-related quality of life (HRQoL), little is known in black African patients compared with control subjects. This study provided the magnitude and the influencing factors of HRQoL impairment in black African outpatients with IBS or CC compared with control subjects using the generic SF-36 questionnaire.

Materials and methods: One hundred and four consecutive black African outpatients complaining with IBS (n=72, mean age=38.9 years, female=62.5%) and CC (n=32, mean age=37.4 years, female=75%) met Rome 3 criteria were compared with 210 control subjects (mean age=37.4 years, 63.8% male). The SF-36 scores in all domains of HRQoL with the corresponding physical (PCS) and mental (MCS) composite scores between groups were compared with post hoc analysis and multivariate linear regression analysis for the assessment of the influencing factors.

Results: Overall, IBS and CC patients exhibited low SF-36 scores in the 8 domains of HRQoL in comparison with control subjects. IBS patients scored less in mental health (mean difference=−10.3, p=0.001), bodily pain (mean difference=−23.5, $p\leq$0.0001), and social functioning domains (mean difference =−15.1, p=0.01) in comparison with CC patients. Post hoc analysis demonstrated a trend down of PCS (mean difference=−12.9, p<0.0001) and MCS (mean difference=−11.2, p=0.01) disfavoring IBS patients than those with CC in comparison with control subjects. In multivariate linear regression analysis, besides the negative impact of IBS and CC, factors influencing PCS were BMI (β=0.4; p=0.01) and comorbidities (β=−5.9; p=0.002). Those influencing MCS were the presence of remunerated activity (β=2.7, p=0.02), and patient living alone (β=9.4; p=0.04).

Conclusion: IBS and CC impact negatively on the HRQoL in black African subjects and more importantly in those with IBS than CC.

Keywords: irritable bowel syndrome, chronic constipation, quality of life, SF-36 questionnaire, black Africans

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Introduction

Irritable bowel syndrome (IBS) and chronic constipation (CC) are both the most prevalent functional gastrointestinal diseases affecting, respectively, 11.2% and 14% of the individuals worldwide with geographical variations.[1,2]

IBS and CC are not life-threatening diseases.[3] However, both impacts negatively on the health-related quality of life (HRQoL) causing high rates of care

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http://doi.org/10.2147/CEG.S192563

seeking behavior, direct and indirect medical costs, low productivity, and absenteeism.[4–10]

Various tools depicting health impairment are used to assess HRQoL in patients with functional gastrointestinal diseases.[11] Among them, generic questionnaires such as the Medical Outcome Short Form quality of life (SF-36) have shown high accuracy and reliable results in Caucasian and Asian patients depicting low scores of HRQoL in patients with IBS and CC.[4,5,12]

The SF-36 is a psychometric evaluation of well-being in its physical and mental dimensions and comprises 36 items questioning various aspects of health status, particularly physical, psychological, and social functioning aspects.[13] Besides diseases and disabilities, age, gender, body mass index, marital status, employment, and income are closely linked to health quality.[14–17]

The previous population-based studies markedly reported an impaired HRQoL in subjects with IBS or CC compared with healthy control subjects.[4,5] Moreover, IBS and CC exerted psychological distress aggravating the impairment of HRQoL of those affected.[3,18,19]

IBS is subdivided into 4 symptomatic profiles and according to the stool pattern and frequency that are IBS with constipation predominant (IBS-C), IBS with diarrhea predominant (IBS-D), IBS with alternating diarrhea or constipation known as mixed IBS (IBS-M), and unclassified IBS.[3]

IBS and CC are prevalent in Africa and are the main reasons for seeking care amongst outpatients, while IBS-C is likely the most frequent subtype encountered in clinical practice.[20–22]

African subjects with IBS express more mystic beliefs regarding the chronicity and bothersomeness of their symptoms than those with CC that may hamper their health quality.[23] In Nigeria, Ladep et al have reported that black Africans with IBS exhibit low scores of HRQoL and psychological distress.[24] However, to our knowledge, there are no data reporting the magnitude of HRQoL impairment in black African subjects with IBS or CC compared with that of healthy control subjects.

Moreover, symptoms overlap between IBS and CC as subjects with CC may experience occasionally more severe abdominal symptoms (discomfort and bloating) than subjects with IBS-C suggesting a fluctuating score of HRQoL according to symptoms onset.[25,26] Little is known about the HRQoL in black African subjects with IBS or CC and relevant influencing factors.

This study was undertaken to determine firstly, the HRQoL in black African subjects with IBS or CC, compared to that of healthy control subjects and, secondly, to assess factors associated with physical and mental dimensions impairment of HRQoL in patients with IBS and CC in African setting and the role of abdominal pain in patient with CC.

Materials and methods

Subjects

One hundred and four consecutive outpatients complaining with IBS (n=72, mean age=38.9 years, female=62.5%) and CC (n=32, mean age=37.4 years, female=75%) met Rome 3 criteria[3] and referred to the gastroenterology units of the three tertiary care university hospitals (Cocody, Yopougon, Treichville) in Abidjan, the economic capital of Côte d'Ivoire from March to September 2016 were enrolled in the study. Outpatients were eligible if they met these following criteria: age ≥15 years old, absence of concomitant organic gastrointestinal diseases, presence of reading and writing skills, and capable to complete the survey questionnaire. Outpatients with organic gastrointestinal diseases such as infectious diarrhea, fever, hepatomegaly, splenomegaly, peptic ulcer, or having low education level or difficulties for reading and understanding words written in French or refusing to participate in the study were not included. For comparison, 210 control subjects (mean age=37.4 years, 63.8% male) were recruited from 3 cities of Côte d'Ivoire (Abidjan, Grand Bassam, and Bonoua). After they have read the consent form and accepted verbally to participate in the survey, both patients and control subjects were asked to complete the questionnaire. Those aged <18 years old completed the questionnaire under parental acceptance. The Ethics committee of the Medical and Scientific Board (Direction Medicale et Scientifique) of the teaching hospital of Yopougon approved the protocol of the study, the verbal consent method, and parental acceptance before the completion of the questionnaire.

The survey questionnaire

The survey questionnaire comprised three sections retrieving social and demographic data, clinical data and items related to SF-36 questionnaire,[13] and stool patterns according to the Bristol stool scale.[27]

In the section retrieving clinical data, subjects were asked to respond to a set of questions (Box 1)

Box 1 Survey questionnaire

i-Do you suffer from chronic constipation. Yes or no?

ii-Do you suffer from irritable bowel syndrome. Yes or no?

iii-How many times did you suffer from chronic constipation or irritable bowel syndrome? Less than 3 years, between 3 and 5 years, more than 5 years

iv-Do you have a regular bowel movement. Yes or no?

v-In these past 4 weeks, do you have difficulties to evacuate stools. Yes or no?

vi-How many times per week do you have a bowel movement: less than 3 times a week, between 2 and 3 times a week or more than 3 times a week?

vii-Do you complain abdominal pain or discomfort. Yes or no?

viii-If so, during these past 4 weeks, how many times have you complain with abdominal pain or discomfort: less than 3 times a week, between 2 and 3 times a week, more than 3 times a week?

ix-Do you have complaints with abdominal pain or discomfort during these past 3 months, 4 months, 6 months?

x-Do you have difficulties to evacuate stools during these past 3 months, 4 months, 6 months?

xi-Please chose on the figure below, the corresponding box (only one choice to be done) depicting the stool pattern that you usually have.

Type 1: Separate hard lumps

Type 2: Lumpy and sausage like

Type 3: A sausage, sharp with cracks in the surface

Type 4: Like a smooth, soft sausage or snake

Type 5: Soft blobs with a clear-cut edge

Type 6: Mushy consistency with ragged edges

Type 7: Liquid consistency with no solid pieces

Note: © 2000 Rome Foundation, Inc. All Rights Reserved.

The SF-36 comprised 36 items or questions depicting the impact of diseases or disabilities on the state of well-being.[13] These 36 items are grouped into 8 domains that are: physical activity (AP), role of physical limitation (RPL), role of emotional limitation (REL), bodily pain (BP), general health (GH), social functioning (SF), vitality (VT), and mental health (MH). The 8 domains are aggregated into 2 composites summaries: physical (PCS) and mental (MCS). The SF-36 score of an individual varies from 0 (minimal score) to 100 (maximal score).

Methods

Administration of the questionnaire

All patients attending the gastroenterology units for symptoms belonging to functional gastrointestinal diseases at the consultation unit were asked to fill the questionnaire, after the explanation of the purpose of the survey. Control subjects were recruited in the main streets of the cities mentioned earlier using a face-to-face interview method.[28] Participants read the consent form and those who gave their consent were asked to fill the questionnaire. The questionnaire was completed by participants without any interference of the surveyor. Additional explanations were given by the surveyor to those who expressed difficulties to understand the meaning of some questions without any interference in the choice of the response.

Collection of data

Social, demographic, and clinical data were retrieved for all participants included in the study comprising, age, gender, medical history, weight, height, body mass index, body mass index, marital status (widowed, married, living with partner, separated), medical history (ongoing disease or treatment), the presence of remunerated activity, stools pattern, the scores of the 8 domains of HRQoL calculated from the 36 items of SF-36 questionnaire (AP, RPL, REL, BP, GH, VT, MH), and the corresponding composites summaries: PCS and MCS.[13]

Definitions

IBS was defined in those experiencing abdominal pain or discomfort occurring 3 times a week during the previous non-consecutive 3 months and lasting more than 6 months with observed changes in stool pattern and frequency.[3] According to bowel movement habits, IBS-C were those having symptoms of CC as stated earlier and picking out from the questionnaire the images of type 1 or 2 as frequent stool pattern exhibited during the bowel movement. Those with IBS-D were those fulfilling also IBS criteria and picking out from the questionnaire the images of type 6 and 7 as frequent stool pattern exhibited during bowel movement according to Bristol stool scale.[27]

CC was defined in those meeting 2 of these following Rome 3 criteria (Box 2)[3]

CC was ascertained when the subjects picked out from the questionnaire the images stools of type 1 or 2 scales as stool pattern frequently exhibited during bowel movement.[27,29]

Painful CC was defined as abdominal pain or discomfort occurring in those meeting Rome 3 criteria of CC but less than 3 times a week.[3,29]

The non-painful CC was the absence of abdominal pain or discomfort in those meeting Rome 3 criteria of CC.[3,29]

Box 2 Rome 3 criteria

i- a stool frequency less than 3 times a week

ii- a strain during bowel movement occurring more than 25% of defecation

iii- a sensation of an incomplete evacuation occurring more than 25% of defecation

iv-a sensation of anal obstruction occurring more than 25% of defecation

v- using digital maneuvers for stools evacuation more than 25% of defecation

vi- the onset of these symptoms above lasting more than 6 months and which have occurred non-consecutively 3 months before the study.

The ulcer-like disease was retained in those declaring to suffer from stomach ulcer without providing its assessment by upper digestive endoscopy and in those reporting burn or epigastric pain referring to functional dyspepsia.[30]

Statistical analysis

Continuous variables were expressed as means and standard deviation if normally distributed, otherwise as median and range. Categorical variables were expressed as number and percentage. The calculation of the 8 domains of HRQoL was assessed using the syntax for SPSS® available on www.umcg.nl and method described by Ware et al.[31,32] The internal consistency of the SF-36 questionnaire was assessed using the Cronbach's alpha estimate.[33] The mean scores of HRQoL comparison between groups were done using the analysis of variance (ANOVA) with post hoc Bonferroni multiple comparison methods and significance level set at 0.02.[34] The subgroup comparison among IBS and subgroups of CC patients was computed using Kruskal Wallis (KW) for nonparametric multiple comparisons using a SAS macro published by Elliot et al.[35] The absence of finite cut-off of SF-36 scores that indicates a good HRQoL,[36] we decided to use multivariate linear regression analysis to determine factors affecting physical and mental dimensions of HRQoL with PCS and MCS as dependant continuous variables. The adjustment variables were age, gender, BMI, remunerated activity, marital status, ongoing disease or treatment, and duration of the disease. The independent variables of interest were CC or IBS compared with the control group and CC compared with IBS. All the analysis was computed with SPSS version 16 and SAS version 9.0 using two sides tailed tests with a significance level less than 0.05.

Results

The characteristic description of enrollment

CC and IBS were found in women in 62.5% and 75%, respectively. Globally, 93 (89.4%) experienced abdominal pain or discomfort occurring more than 3 times a week in 41 (39.4%) patients, lasting more than 5 years in 55 (63.5%) patients. Irregular bowel movements were reported by 25 (24%) patients and 96 (37.5%) declared having less than 3 stools evacuations per week, mostly of type 1 (39.4%) and type 2 (20.2%) according to the Bristol stool scale. In addition to IBS or CC, 25 (29.8%) patients declared comorbidities (diabetes: 2 patients, arterial hypertension: 6 patients, ulcer-like pain: 23 patients). In contrast with the result of Rome 3 criteria, 54 (51.4%) and 50 (48.1) of interviewed patients self-reported having, respectively, IBS and CC. Baseline characteristics are depicted in Table 1. Based upon Rome 3 criteria, IBS-C was seen in 42 (58.3%) and diarrhea-predominant IBS in only 1 (14.4%) among patients with IBS. The remaining IBS patients (40.1%) were considered as having unclassified IBS (Table 1).

Distribution of SF-36 scores in the population of the study

As shown in Table 2, patients with IBS or CC obtained low SF-36 scores in the 8 domains compared to that of control subjects. More importantly, IBS patients had significantly lower SF-36 scores in 6 domains in comparison with CC patients except for PF and VT. Overall, PCS and MCS were profoundly low in IBS patients (mean differences of – 30.9 and –23.6, respectively) than that of CC patients (mean differences of −18 and −12, respectively) in comparison with control subjects. Overall, the internal consistency of the SF-36 questionnaire in our study was high with a Cronbach's alpha estimate of 0.87. Within the subgroups, the Cronbach's alpha estimates were 0.84, 0.81, and 0.76 in IBS, CC, and control groups, respectively.

There were any significant differences of the median or mean values of SF-36 scores adjusted with gender (Table 3) and age (Figure 1) within all subgroups of subjects with IBS, CC, or control groups.

Table 1 Baseline characteristics at inclusion

Sociodemographic and clinic parameters	IBS (n=72)	CC (n=32)	Controls (n=210)	
Demographic parameters				*P*-value
Age (years) [mean(SD)]	38.9(10.5)	37.4(9.3)	37.8(9)	0.6
Age in class (years)[n(%)]				
15–30	14(19.4)	6(19)	45(21.4)	
31–40	29(40.3)	18(56.2)	93(44.3)	
41–50	20(28)	6(19)	55(26.2)	
51–60	6(8.3)	1(3.1)	12(5.7)	
≥61	3(4.2)	1(3.1)	5(2.4)	
Gender (Female)[n(%)]	45(62.5)	24(75)	76(36.2)	<0.0001
BMI	25.1(5.6)	25.9(5.9)	25.4(5)	0.8
Marital status (yes) **[no(%)]**				<0.0001
Married	33(45.8)	13(40.6)	91(43.3)	
Living with a partner	11(15.3)	2(6.2)	49(23.3)	
Widowed	1(1.4)	0(0)	17(8.1)	
Single	23(31.9)	17(53.1)	38(18.1)	
Living alone	3(4.2)	0(0)	15(7.1)	
Remunerated activity (yes)[no(%)]	46(63.9)	23(71.9)	141(67.1)	0.7
Medical history				0.1
Arterial hypertension	3(4.2)	3(9.4)	18(8.6)	
Diabetes	1(1.4)	1(3.1)	4(1.9)	
Epigastralgia	16(22.2)	7(21.9)	23(11)	
None	51(70.8)	19(59.4)	147(70)	
Comorbidities (yes)[n(%)]	21(28.2)	13(40.6)	63(30)	
Functional symptoms				
Abdominal pain or discomfort	72(100)	21(65.6)	34(16.2)	NA
Regularity of bowel movement (yes)[n(%)]	18(25)	7(21.9)	202(96.2)	<0.0001
Number of bowel movement per week [n (%)]				
<2	25(34.7)	14(43.8)	0(0)	
2–3	27(37.5)	12(37.5)	1(0.5)	
>3	20(27.8)	6(18.8)	208(99)	
Duration of symptoms (years)[n(%)]				
<5	25(34.7)	14(43.8)	0	NA
5–10	19(26.4)	10(31.2)	0	
10–15	15(20.8)	4(12.5)	0	
>15	13(18.1)	4(12.5)	0	
Bristol stool scale [n (%)]				<0.0001
Type 1	26(36.1)	15(46.9)	0(0)	
Type 2	16(22.2)	5(15.6)	6(2.9)	
Type 3	13(18.1)	7(21.9)	13(6.2)	
Type 4	14(19.4)	5(15.6)	97(46.2)	
Type 5	2(2.8)	0(0)	55(26.2)	
Type 6	1(14.4)	0(0)	29(13.8)	
Type 7	0(0)	0(0)	10(4.8)	

Notes: The comparison was computed between irritable bowel syndrome and chronic constipation versus controls. NA, non-applicable between the two groups because variables entered in the definition of irritable bowel syndrome or painful chronic constipation (Abdominal pain or discomfort) or not assessed in the control group (duration of symptoms).
Abbreviations: IBS, irritable bowel syndrome; CC, chronic constipation; SD, standard deviation.

Table 2 Mean scores of SF-36 questionnaire items and differences comparison between groups

	Mean values (standard deviation)			Mean differences (standard error of difference) between groups					
	IBS	CC	Ct	IBS vs CC	*p*	IBS vs Ct	*p*	CC vs Ct	*p*
PF	83.3(10.8)	85.5(15.4)	95.7(8.6)	−2.1(2.6)	0.4	−12.4(1.4)	0.0001	−10.3(2.8)	0.001
RP	41.3(42.4)	58.6(39.5)	78(28.2)	−17.2(8.8)	0.05	−36.7(5.4)	0.0001	−19.4(5.7)	0.01
RE	41.2(42.8)	60.4(42.7)	77.5(31.2)	−19.2(9.1)	0.04	−36.7(5.4)	0.0001	−17.1(7.9)	0.04
BP	50.5(31)	74(25)	96.3(11.3)	−23.5(6.2)	0.0001	−45.8(3.7)	0.0001	−22.3(4.5)	0.0001
SF	58.1(29)	73.2(26.4)	84.6(22.4)	−15.1(6)	0.01	−26.4(3.8)	0.0001	−11.3(4.9)	0.01
VT	35.8(15.4)	36.3(14.3)	52.7(15.7)	−0.4(3.2)	0.8	−16.9(3.7)	0.0001	−16.5(2.9)	0.0001
MH	44(13.7)	54.3(12)	58.7(12.8)	−10.3(2.8)	0.0001	−14.7(1.8)	0.0001	−4.4(2.4)	0.1
GH	45.8(21.2)	54.4(17.9)	74.5(13.5)	−8.6(4.3)	0.05	−28.7(2.7)	0.0001	−20.1(3.3)	0.0001
PCS	55.2(21.6)	68.1(19.6)	86.1(10.7)	−12.9(4.5)	0.01	−30.9(1.9)	0.0001	−18(3.5)	0.0001
MCS	44.8(20.4)	56(19.1)	68.4(15.3)	−11.2(4.2)	0.01	−23.6(2.6)	0.0001	−12.4(3)	0.0001

Abbreviations: IBS, irritable bowel syndrome; CC, chronic constipation; Ct, controls; PF, physical functioning; RP, role of physical; RE, role of emotional; BP, bodily pain; SF, social functioning; GH, general health; VT, vitality; MH, mental health; PCS, physical composite score; MCS, mental composite score.

Table 3 Distribution of the scores of SF-36 questionnaire according to the gender within the subgroup of subjects with irritable bowel syndrome, chronic constipation, or control subjects

	Median values (range) of SF-36 scores								
	IBS			CC			Control subjects		
	Female	Male	*p*-value	Female	Male	*p*-value	Female	Male	*p*-value
PF	80(35)	85(45)	0.4	85(65)	95(15)	0.1	100(50)	100(45)	0.8
RP	25(100)	25(100)	0.2	63(100)	88(100)	0.7	100(100)	100(100)	0.6
RE	33(100)	100(100)	0.7	67(100)	83(100)	0.9	100(100)	100(100)	0.3
BP	50(100)	67(100)	0.4	75(83)	83(100)	0.6	100(43)	100(86)	0.3
SF	57(100)	57(100)	0.5	71(86)	79(71)	0.6	100(57)	100(71)	0.2
VT	35(80)	35(60)	0.8	40(50)	28(45)	0.4	50(55)	50(60)	0.7
MH	44(56)	40(72)	0.7	54(36)	52(44)	0.5	60(44)	60(60)	0.4
GH	45(80)	50(85)	0.4	55(70)	60(50)	0.9	75(65)	70(50)	0.7
PCS	54(71)	51(70)	0.8	71(63)	83(53)	0.4	88(48)	88(53)	0.5
MCS	37(75)	40(75)	0.9	60(60)	64(59)	0.8	71(54)	69(55)	0.7

Abbreviations: IBS, irritable bowel syndrome; CC, chronic constipation; PF, physical functioning; RP, role of physical; RE, role of emotional; BP, bodily pain; SF, social functioning; GH,general health; VT, vitality; MH, mental health; PCS, physical composite score; MCS, mental composite score.

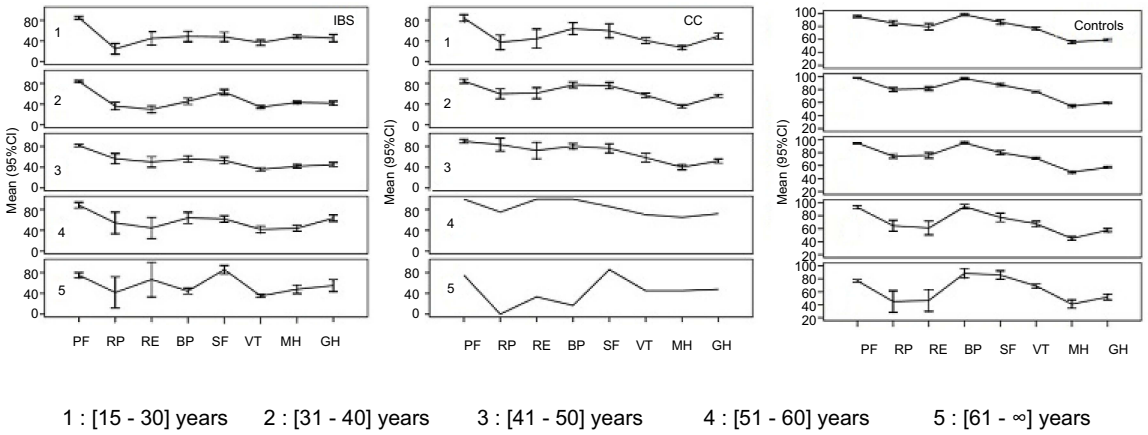

Figure 1 Distribution and trend of means scores of SF-36questionnaire items adjusted to age within all subgroups. Lines were smoothed because of the presence of one subject in the belonging age class.

Abbreviations: IBS, irritable bowel syndrome; CC, chronic constipation; Ct, controls; PF, physical functioning; RP, role of physical; RE, role of emotional; BP, bodily pain; SF, social functioning; GH, general health; VT, vitality; MH, mental health; PCS, physical composite score; MCS, mental composite score.

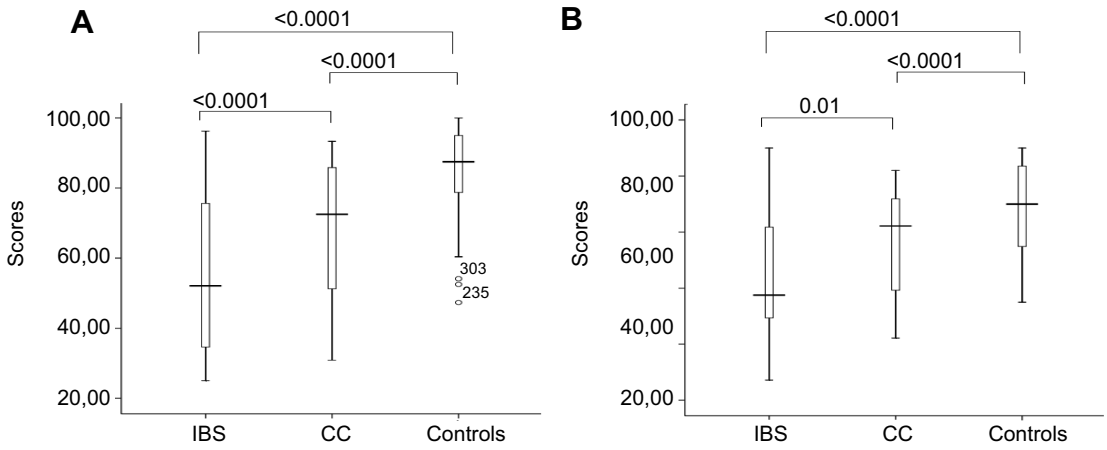

Figure 2 Box plots depicting the distribution and trends of physical (**A**) and mental (**B**) composite scores between patients with irritable bowel syndrome, chronic constipation, and control subjects. The box represents the interquartile range; the top and the bottom of the box are, respectively, the 25th and 75th percentile. The line across the box is the median. The lower and upper values are indicated by the whiskers. Stars and circles represent the outliers and extreme values.
Abbreviations: IBS, irritable bowel syndrome; CC, chronic constipation.

Post Hoc comparisons of the SF-36 scores

Post hoc analysis demonstrated that IBS patients had low PCS (mean difference=−12.9, p=0.01) and MCS (mean difference=−11.2, p=0.02) compared with CC patients. There was a trend down of PCS and MCS disfavoring IBS patients compared with CC patients and control subjects (Figure 2). IBS patients scored less in MH domain (mean difference=−10.3, p=0.001), BP domain (mean difference=−23.5, $p\leq$0.0001), and SF domain (mean difference =−15.1, p=0.01) in comparison with CC patients (Table 2).

Influence of abdominal pain on HRQoL in patients with CC compared with IBS patients

Among the 32 patients with CC, 21 (65.6%) complained about abdominal pain. There were no differences between age and gender between groups. As shown in Figure 2, the overall comparison of the median score values of PCS (p=0.01) and MCS (p=0.03) was significantly different between IBS patients and subgroups of patients with no pain and painful CC. The post hoc analysis showed that IBS patients exhibited significant impairment of HRQoL both on its physical (median values of PCS: 52.1 vs 72.5, KW post hoc test=2.76, DF=2, p<0.05) and mental (median value of MCS: 37.5 vs 62.7, KW post hoc test=2.91, DF=2, p<0.05) dimensions than those with painful CC. In contrast, patients with no painful CC have a similar pattern of PCS (72.5 vs 52.1; p=ns) and MCS (53 vs 37.5; p=ns) in comparison with IBS patients (Figure 3).

Factors influencing the HRQoL between CC and IBS patients compared with control subjects

Influencing factors of HRQoL in comparison with control subjects

In multivariate analysis using control subjects, factors lowering PCS were comorbidities (β=−5.9, 95% IC=−9.7, −2.1, p=0.02), IBS (β=−30.1, 95% IC=−34, −26.2, p<0.0001), and CC (β=−17.3, 95% IC=−22.8, −11.9, p<0.0001) and the enhancing factor was BMI (β=0.4, 95% IC=0.1, 0.7, p=0.02).

For MCS, the lowering factors were IBS (β= −23.3, 95% IC= −27.9, −18.7, p<0.0001) and CC (β=−11.8, 95% IC=−18.3, −5.3, p=0.0004) and the enhancing factors were remunerated activity (β=2.7, 95% IC=0.4−5.1, p=0.02) and patient living alone (β=9.4, 95% IC=0.6, 18.3, p=0.04).

Factors influencing the HRQoL in the subgroup of patients with IBS or CC

Both BMI and a remunerated activity remained the enhancing factors of HRQoL when comparing IBS and CC patients. The duration of symptoms did not appear as a lowering factor (Table 4).

Discussion

We have demonstrated in this study that black African patients with IBS and CC exhibit low HRQoL in comparison with control subjects. The mean differences of SF-36 scores in all dimensions of HRQoL were

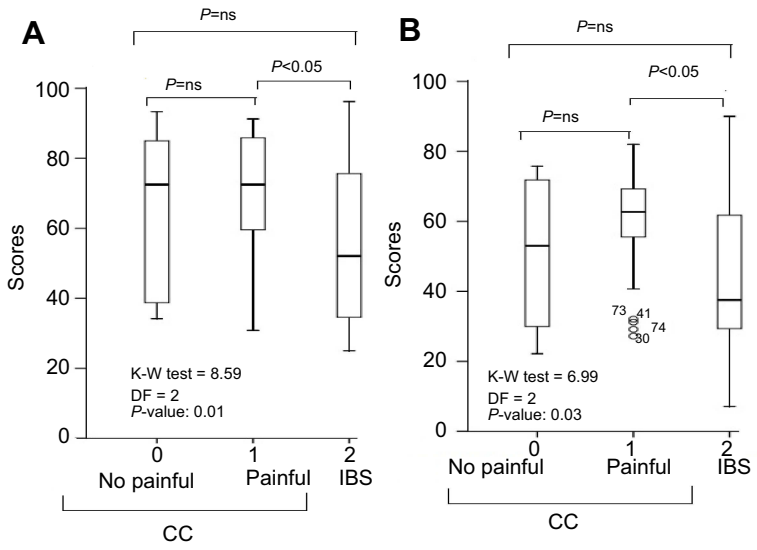

Figure 3 Box plots depicting the distribution, comparison, and trends of physical (**A**) and mental (**B**) composite summaries between subjects with no painful chronic constipation (0), painful chronic constipation (1) and irritable bowel syndrome (2). The box represents the interquartile range; the top and the bottom of the box are, respectively, the 25th and 75th percentile. The line across the box is the median. The lower and upper values are indicated by the whiskers. Stars and circles represent outliers and extreme values. SE: standard error, Q = calculated statistic, Q(0.05): the critical value of tabled Q statistic =2.39. KW = Kruskal Wallis test.
Abbreviations: IBS, irritable bowel syndrome; CC, chronic constipation.

Table 4 Predictive factors affecting physical and mental composite summaries of the SF-36 scores in subjects with irritable bowel syndrome compared with those with chronic constipation: multivariate regression analysis

	PCS		*p*	MCS		*p*
	β	95%CI		β	95%CI	
BMI	1.2	0.5, 1.9	0.001	0.91	0.2, 1.6	0.01
Remunerated activity (yes)	8.2	0.1, 16.2	0.05		-	-
Duration of symptoms (years)					-	-
<5 years	1	-	-		-	-
5–10	0.8	−8.8, 10.3	0.9		-	-
10–15	−9.9	−20.7, 0.9	0.07		-	-
>15	−1.2	−12.4, 10.0	0.8		-	-
IBS vs CC	−10.3	−18.5, −2.03	0.02	−9.9	−18.1, −1.9	0.02

Notes: Adjusted R for PCS=0.21, Adjusted R for MCS=0.13. Bristol stool scale was not included in the analysis.
Abbreviations: PCS, physical composite summary; MCS, mental composite summary, β=regression coefficient; CI, confidence interval; BMI, body mass index; IBS, irritable bowel syndrome; CC, chronic constipation.

significantly lower in IBS patients than in CC patients in comparison with controls. Moreover, IBS patients have a profound impairment of HRQoL in comparison with CC patients. Painful constipation did not seem to reduce HRQoL in comparison with IBS. Besides CC and IBS, factors affecting HRQoL were BMI, marital status, and the presence of remunerated activity.

IBS and CC are known to impair HRQoL in several clinical studies from the western and Asian countries. Both IBS and CC patients exhibit lower SF-36 scores in all domains of HRQoL in comparison with US normative data and elsewhere, similar to our findings in Ivorian patients with IBS and CC.[4,5,12,37]

However, the magnitude of HRQoL impairment may differ between IBS and CC patients regarding the 8 domains of the SF-36 questionnaire in comparison with healthy subjects.[38,39] In the study of Ruiz-Lopez, IBS-C and CC patients exhibit similar scores in the domains of physical functioning, role of physical limitation, role of emotional limitation, and general health except for vitality.[38] Meanwhile in the study of Zhao et al, in Chinese patients using Rome 2 criteria, only mental health was significantly lower in IBS-C patients compared with

CC patients.[39] We have found similar results of the mean SF-36 scores on physical functioning and vitality domains between IBS and CC patients and low scores for other domains, particularly role of emotional limitation, social functioning, general health, and mental health. Moreover, in our study, the HRQoL was more profoundly affected in IBS patients with a disfavoring trend down of physical and mental composite scores. Similar patterns of HRQoL have been described in German subjects with IBS-C compared with those having functional constipation.[40] However, in the study of Wong et al, in the United States, using the same profile of subjects and the SF-12 questionnaire, only the mental composite score was affected in IBS-C patients in comparison with subjects with functional constipation (48.9 vs 52.4, $p<0.001$).[41]

This discrepancy suggests different patterns of HRQoL. In Côte D'Ivoire, IBS and CC may alter both physical and mental dimensions of state of well-being and, more importantly in IBS subjects that may lead to anxiety and depression as reported in Nigerian IBS subjects.[18,19,24] We have previously reported in Côte d'Ivoire that IBS subjects expressed mystic beliefs than those with CC.[23] The valuable explanation is that, in Africa, the disease perception is surrounded by mysticism leading to psychological distress owing to the chronicity and bothersomeness of the underlying disease.[4–10,42]

IBS patients seeking care exhibit more severe symptoms and a high degree of anxiety compared with non-consulters and display low scores in physical functioning and role of physical functioning.[43] In this study, physical functioning and vitality scores were lower compared with that of control subjects, but similar between IBS and CC patients, suggesting the existence of other factors that could motivate IBS and CC patients to seek care in an African setting.

Painful and no painful CC patients in our study have similar physical and mental composite scores of the SF-36 questionnaire. Painful constipation symptoms did not seem to alter the HRQoL of those with CC in comparison with IBS patients, probably due to the infrequent onset of pain during the course of constipation, even though, painful CC and IBS-C subjects have more symptoms of constipation than those with no painful constipation.[3,29] However, the clinical spectrum of CC and IBS marked by the overlap of their symptoms may explain the same results of physical and mental composite scores of SF-36 questionnaire between non-painful constipation and IBS patients in our study.[3,29]

It was not surprising to find out that comorbidities were factors associated with physical dimension impairment of HRQoL. Diseases and disabilities are common sources of health quality impairment in human being.[44] The beneficial effect of BMI on the physical component of HRQoL may be attributed to the mean value within the normal range of this variable in our study and closely linked to a better HRQoL in comparison with underweight or overweight subject.[45] A remunerated activity may provide subsidies that promote a better well-being.[14] Moreover, even though marriage status enhances good quality of life, the absence of marriage constraints in the African context may explain probably the favorable mental well-being of those living alone in our study.[46,47]

The main limitation of our study was the absence of finite characterization of the defecation pattern (straining, anal blockage, digital maneuver) exhibited by patients.[3,48] IBS and painful CC are considered by some authors as two entities of the same disease that do not stabilize over time, which can lead to misclassification of patients due to the symptoms overlapping.[40,41,49] Finally, the absence of cultural adaptation of the SF-36 questionnaire into local languages limits the generalizability of our results to nonliterate subjects in Côte d'Ivoire.[50]

However, our study provided new insights into the HRQoL in black African patients with IBS and CC. Finally, the results of HRQoL in patients with IBS and CC were globally in the line of previous reports confirming the reproducibility of the SF-36 questionnaire, whatever the environment and type of patients.[4,5,12]

In conclusion, IBS and CC impact negatively on the HRQoL in black African subjects in Côte d'Ivoire and more importantly in those with IBS-C. The assessment of HRQOL may be used to distinguish between IBS-C subjects and those with painful CC in order to motivate the use of the more psychological treatment in the former in an African setting.[51]

Acknowledgments

We want to thank Mr Gadafi Iddrisu Balali, Department of Theoretical and Applied Biology, Kwame Nkrumah University of Science and Technology, Kumasi Ghana, for having corrected the English translation of the manuscript.

Disclosure

Dr Alassan Kouamé Mahassadi reports personal fees and non-financial support from Genix Pharma and Sanofi, outside the submitted work. The authors report no other conflicts of interest in this work.

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Coming to terms with constipation

There are several remedies for this common symptom, which is rarely a sign of serious illness.

Constipation affects women more than men and is more likely to occur at certain times, including pregnancy and in the days preceding menstruation, and becomes increasingly common after menopause. While constipation can cause discomfort and anxiety, it is usually not a symptom of a serious condition. However, it can often be difficult to determine just why someone is constipated.

Constipation isn't a simple problem. It is characterized by fewer than three bowel movements a week, hard dry stools, straining to move one's bowels, and a sense of an incomplete evacuation. "It also has many causes," says Dr. Kyle Staller, a gastroenterologist at Harvard-affiliated Massachusetts General Hospital. He notes the factors that cause symptoms can vary, depending on whether the condition is sporadic (occurring occasionally) or chronic (persisting for months or years).

Causes of sporadic constipation

An occasional episode or new bout of constipation can be brought on by any of the following:

Inadequate dietary fiber. The Food and Nutrition Board of the Institute of Medicine recommends 25 grams of dietary fiber per day for women ages 50 and younger, and 21 grams per day for women over 50. Most Americans consume much less fiber than these amounts.

Medications. For many older people, use of certain medications is one of the most frequent causes of constipation. Common culprits include tricyclic antidepressants, opioid pain relievers, incontinence medications, over-the-counter cold remedies, and nonprescription sleeping pills.

Lifestyle disruptions. Sudden changes in your daily routine—for example, travel or hospitalizations—can disturb your bowel habits. Your colon generally sleeps when you do, so waking up can induce colon contractions. Meals can also trigger colon contractions. That means if you change your sleeping habits or mealtimes suddenly, your colon may take time to catch up.

Lack of exercise. Exercise also stimulates colon contractions, so being sedentary or bedridden can lead to constipation.

Treating sporadic constipation

Most successful treatments address the causes directly. Here are some options:

Increased dietary fiber. Fiber absorbs water, which adds bulk to the stool, forming soft, heavy stool that stimulates colon contractions and passes more easily through the rectum. Whole-grain foods, brans, fruits, and vegetables are good sources of fiber. If dietary fiber alone isn't effective you may want to add a soluble fiber supplement containing psyllium seed (Metamucil), calcium polycarbophil (FiberCon), or methylcellulose (Citrucel). It's important to drink plenty of liquid with soluble-fiber supplements, because failing to do so can create a gel or sludge that worsens constipation.

Osmotic laxatives. These products, which bring water into the colon to bulk up the stool, are considered safe and effective. Common preparations include polyethylene glycol (Miralax) and lactulose (Constulose, Cholac).

Exercise. It's always a good idea to get at least 150 minutes of moderate exercise—or 75 minutes of vigorous exercise—a week. To promote regularity, strive for a 30-minute daily walk.

Causes of chronic constipation

The complex interaction of the nervous system and the digestive system plays an important role in chronic constipation. Neurologic disorders, such as Parkinson's disease, spinal cord injury, stroke, or multiple sclerosis can cause constipation. So can metabolic and endocrine disorders, such as hypothyroidism and diabetes.

In many people with chronic constipation, the colon contracts less frequently than normal, and food passes too slowly through the colon. The longer fecal matter is in the colon, the greater the amount of water that is drawn out of it and into the colon walls. As a result, stools become hard, dry, and difficult to pass through the rectum. In some people, a normal stool may reach the rectum, but the pelvic floor muscles don't contract forcefully enough to pull the rectum up over the feces and allow the stool to pass.

Treating chronic constipation

The stool-bulking treatments that alleviate sporadic constipation—increasing dietary fiber or adding supplemental fiber and osmotic laxatives—may also help with chronic constipation. Stimulant laxatives like bisacodyl, casanthranol, cascara, castor oil, and senna may be used in low doses for chronic constipation, Dr. Staller says.

Physical manipulation may be helpful. Abdominal massage and perineal self-acupressure—pressing on the area between the anus and vaginal opening—are two common techniques.

Finally, "comfort-height" toilets may be making it harder to have a bowel movement by eliminating squatting, which reflexively relaxes the pelvic floor. If you have a comfort toilet, you can still achieve the squatting position by propping your feet up on a low (7-inch to 8-inch) stool to raise your knees above your hips.

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Perspective on Physical Therapist Management of Functional Constipation

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[George SE, Borello-France DF. Perspective on physical therapist management of functional constipation. Phys Ther. 2017;97:478–493.]

Published Ahead of Print: September 15, 2016
Accepted: August 28, 2016
Submitted: March 9, 2016

Functional constipation is a common bowel disorder leading to activity restrictions and reduced health-related quality of life. Typically, this condition is initially managed with prescription of laxatives or fiber supplementation, or both. However, these interventions are often ineffective and fail to address the underlying pathophysiology and impairments contributing to this condition. Physical therapists possess the knowledge and skills to diagnose and manage a wide range of musculoskeletal and motor coordination impairments that may contribute to functional constipation. Relevant anatomic, physiologic, and behavioral contributors to functional constipation are discussed with regard to specific constipation diagnoses. A framework for physical therapist examination of impairments that can affect gastrointestinal function, including postural, respiratory, musculoskeletal, neuromuscular, and behavioral impairments, is offered. Within the context of diagnosis-specific patient cases, multifaceted interventions are described as they relate to impairments underlying functional constipation type. The current state of evidence to support these interventions and patient recommendations is summarized. This perspective article aims not only to heighten physical therapists' awareness and management of this condition, but also to stimulate clinical questioning that will open avenues for future research to improve patient care.

Constipation is a symptom-based disorder characterized by "infrequent stools and/or difficulty with stool passage"[1(p S8)] and reported by 1.9% to 27.2% of adults in the United States.[2,3] Although constipation has proven difficult to categorize due to its multifactorial pathophysiology, it is generally divided into 2 types: (1) primary constipation with functional impairment of the colon and anorectal structures and (2) secondary constipation related to organic or structural disease, systemic disease, or medications.[4] Severe constipation has been defined as <1 bowel movement (BM) per week.[5] Bowel movement frequency ≤1 time per week is reported more commonly by women, at a rate 3.5 times greater than that of men.[6] Severe constipation also is quite common among individuals residing in nursing homes (44%–74%)[7–9] and in people who are postoperative for hip fracture,[10] those with joint hypermobility,[11] and those with neurologic conditions.[12,13] In addition, the 2002 National Health Interview Survey revealed that individuals with back or neck pain reported a higher percentage of gastrointestinal conditions (inflammatory bowel disease, irritable bowel, or severe constipation) compared with those without such pain.[14] Constipation also affects children (0.7%–29.6%),[15] women who are pregnant (11%–38%),[16] and young female athletes (29% nonintensive sport category and 36% intense sport category).[17] Thus, it is quite likely that a physical therapist, regardless of practice specialty, will encounter patients troubled by constipation. Yet, individuals with constipation may not reveal this or other pelvic symptoms (urinary incontinence, fecal incontinence, pelvic organ prolapse, or pelvic pain) due to embarrassment or because they are seeking physical therapist services for another condition that they perceive to be unrelated.

Chronic constipation symptoms at any age can lead to reduced activity and work productivity. In addition, individuals with chronic constipation are more likely to utilize health care resources (physician and emergency department visits) compared with matched controls.[18] Community-based studies indicate that the magnitude of health-related quality-of-life impact in adults with constipation is similar to that reported by those with diabetes, chronic allergies, dermatitis, and osteoarthritis.[19] For studies of hospital-based adults, the impact was comparable to and overall greater than that felt by people with unstable Crohn disease, functional dyspepsia, and rheumatologic conditions.[19] In the pediatric population, children with constipation reported worse health-related quality-of-life impact than that of peers with inflammatory bowel disease and gastroesophageal reflux disease. In addition, parents consistently rated quality-of-life impact associated with their child's constipation to a greater degree than their own child's rating.[19]

A systematic review of the epidemiology of constipation in children and adults showed that there is an increased tendency toward constipation with age; sex (female adults); lower social, economic, and education level, possibly related to diet and lifestyle habits associated with low socioeconomic status; high body mass index; and reduced mobility or low self-reported physical activity.[15] Additionally, the review identified at least one study[15] supporting the following risk factors: low consumption of fruit, vegetables, and fiber; living in a highly densely populated community; family history of constipation; and anxiety, stressful life events, and depression.

The high prevalence of constipation, the breadth of individuals substantially affected by this condition, and risk factors that may be modifiable through education and physical exercise render the topic of constipation relevant to physical therapists in all areas of practice. Although the role and responsibility of all physical therapists is to improve the overall health and function of their patients, we recognize that we cannot adequately address both adult and childhood constipation and all types of constipation in a single perspective article. Therefore, this perspective article focuses on adult functional constipation disorder only. This perspective article aims to increase physical therapists' knowledge and ability to recognize, diagnose, and make management decisions (intervene with most appropriate evidence-based physical therapy interventions or referral to a specialist physician or physical therapist, or both) for those individuals with functional constipation. This article also aims to describe the nomenclature and pathophysiology of constipation, briefly discuss the medical management of constipation, and provide a comprehensive, evidence-based guide to the physical therapist management of constipation.

Nomenclature and Pathophysiology

Functional (idiopathic) constipation presents no identifiable biochemical or direct structural cause for change in stooling patterns,[4] but rather indicates that the interactive physiology (or function) of these anatomical structures is impaired.[20] Experts have worked to establish symptom-based classification schemes (eg, Rome III diagnostic criteria[21]) to best define functional constipation and related functional defecation disorders (DD) to direct medical management. According to the Rome III diagnostic criteria, a diagnosis of functional constipation must include the presence of ≥2 of the following criteria during at least 25% of defecations: straining to defecate, lumpy or hard stools, sensation of incomplete evacuation, sensation of anorectal obstruction or blockage, digital maneuvers to defecate, and <3 BMs per week. In addition, the diagnosis must include that loose stools are rarely present without use of laxatives, there are insufficient criteria for irritable bowel syndrome, and the criteria must be present for the past 3 months, with symptom onset at least 6 months prior to diagnosis. Although no one classification scheme fits all patients, these criteria appear to be widely accepted and provide a framework for further understanding.[4]

Functional constipation can be further divided into 3 general subgroups: normal transit constipation (NTC), slow transit constipation (STC), and DD (Fig. 1).[4,22] Defecation disorders can coexist with NTC and STC. Studies have shown that 40% to 50% of patients with DD also experience STC.[23]

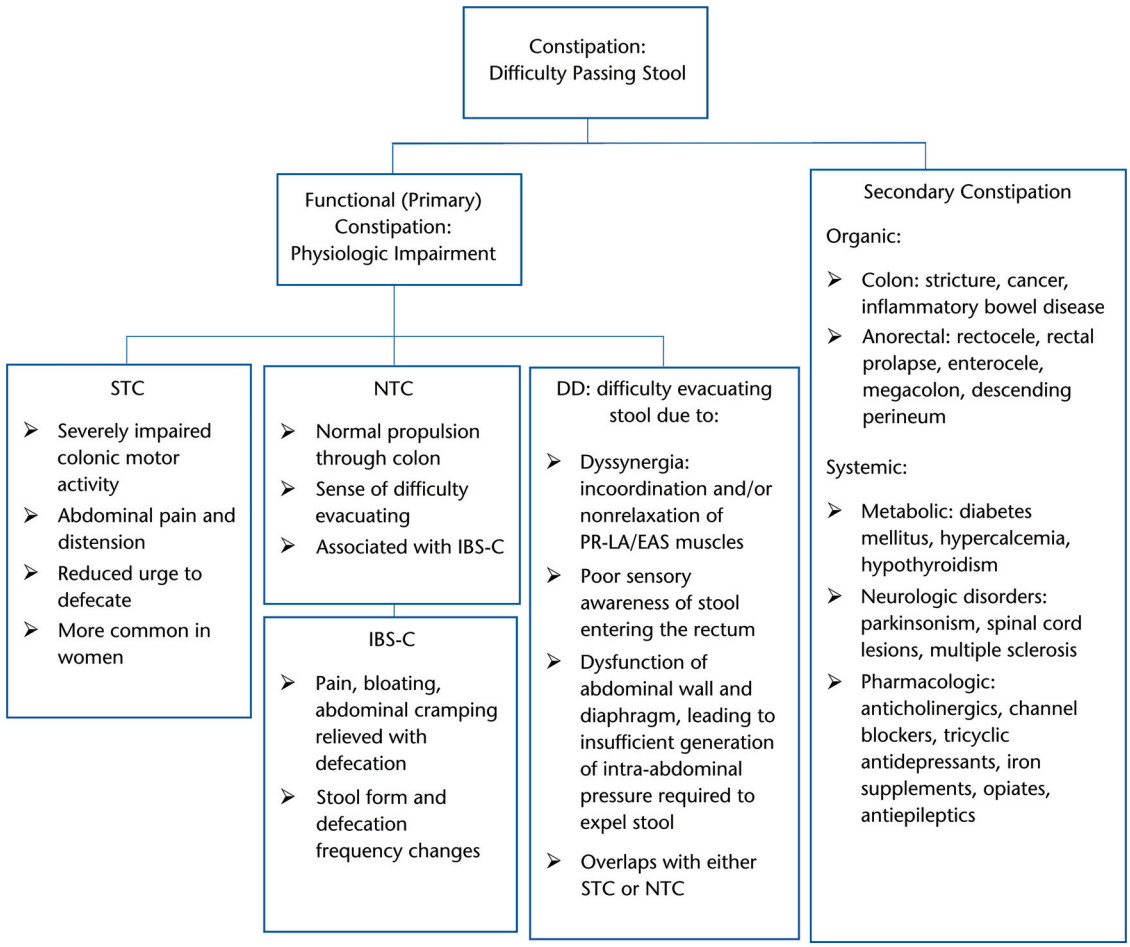

Figure 1.
Type of constipation, characteristics, and etiology.[1,3,4,22,24,26,30,32–36,38] Two types of constipation are illustrated: (1) primary or functional constipation and (2) secondary constipation. There are 3 subtypes of functional constipation: normal transit (NTC), slow transit (STC), and defecation disorders (DD). Characteristics and associated etiology are presented in the figure. Irritable bowel syndrome-constipation dominant (IBS-C) can overlap with NTC. PR-LA=puborectalis muscle of the levator ani muscle, EAS=external anal sphincter.

Slow transit constipation is characterized by infrequent urges to defecate, abdominal pain, and distension[22] and is most commonly seen in younger women, with symptom onset at puberty.[24] Normally, each day, 1.5 L of fluid enters the colon, but only 200 to 400 mL of this fluid is excreted in order to preserve fluid and electrolyte homeostasis in the body. With slowed movement of stool through the colon, an excessive amount of fluid is reabsorbed from the lumen of the colon, leading to hard stool and difficulty with evacuation. Slow transit constipation is generally found to be an autonomically driven neuromuscular disorder of the colon with both local and central triggers, including stress and disturbed sleep, pharmacology (opioids, antacids, antidepressants, antihistamines, blood pressure medications, iron and calcium supplements), and impaired function of the colonic pacemaker cells of Cajal.[25,26] In healthy humans, rectal distension has been found to reduce colonic motor activity via a viscerovisceral reflex called the rectocolonic inhibitory reflex.[27] Persistent rectal distension associated with disordered defecation has been linked to STC.[3,28] In addition, rectal distension has been associated with blunting of peristalic triggers, including waking, eating, and drinking.[29]

Defecation disorders (also termed "outlet obstruction") are characterized by difficult defecation associated with straining, longer toileting time to produce a BM, and manual assistance to complete rectal emptying (posterior vaginal wall/perineal splinting or anal digitation).[3,30] The Rome III criteria also describe the disorder.[31] Contributors to DD may include dyssynergic defecation (uncoordinated or nonrelaxing external anal sphincter [EAS] and puborectalis muscle of the levator ani muscle [PR-LA]); rectal hyposensitivity due to either afferent nerve dysfunction or excessive rectal wall distension, thus requiring larger stool volumes to trigger defecation; and insufficient rectoabdominal coordination to evacuate stool.[26,32–35] Disordered defecation may be a learned behavior created by repeatedly deferring defecation despite experiencing fecal urgency either

for personal convenience or due to fear of painful BMs.[35] Fecal matter may then either remain in and subsequently distend the rectum or retropulse into the left colon where stool becomes hard and dry.[35]

Normal colonic transit is characterized by normal colonic stool movement, but the individual perceives difficult defecation or hard stools. Patients also may experience increased rectal compliance/stretch along with reduced sensory awareness of stool in the rectum.[36] Normal transit constipation responds best to increased fiber and osmotic laxatives. Fiber and osmotic laxatives work by pulling water from the colon's mucosal lining into the lumen.[37] Increased distension and abdominal pain/discomfort may be reported, and NTC is often found to overlap with constipation-dominant irritable bowel syndrome.[38]

Initial Medical Management

Individuals with constipation usually first seek help from their primary care physician for symptom resolution. First-line primary care management typically includes prescription of laxatives and advice to increase fiber intake.[39] However, in patients with constipation due to STC or DD, fiber intake of up to 30 g per day does not produce any symptom change.[37] In addition, one survey that aimed to assess patient satisfaction with traditional constipation therapies showed that 60% and 50% of the respondents were dissatisfied with over-the-counter and prescriptive laxatives, respectively, to provide symptom relief.[40] These data call into question both the efficacy and cost-effectiveness of fiber and laxative interventions as the sole management of functional constipation, leaving >50% of the participants in this study with inadequate management. That is, these interventions fail to address major impairments underlying this condition (ie, motor incoordination and poor anorectal sensory awareness).[40] Unfortunately, when such interventions fail over a period of months or years, patients may be deemed as refractory to medical management. As a result, more invasive medical procedures may be offered, including implantation of sacral stimulators or other more radical surgical interventions (colectomy).[41,42]

Neuromuscular and Behavioral Management

First-line management of functional constipation should consider interventions that target neuromuscular impairments (sensory and motor coordination) and correct behaviors that are detrimental to overall health including bowel function. Not only does this approach have the potential to reduce the need for invasive or radical procedures, but it is holistic in that it considers other pelvic symptoms (urinary incontinence, fecal incontinence, pelvic organ prolapse)[43] that coexist in people with bowel disorders. Coexisting pelvic symptoms can be attributed to poor toileting habits. For example, studies have shown that 50% to 85% of women do not sit on, but hover over, public toilets due to cleanliness concerns.[44,45] This toileting position may interfere with relaxation of pelvic-floor and urinary sphincter muscles during micturition.[44] With regard to defecation, it has been shown that increasing the angle of hip flexion (in relaxed sitting) straightens the anorectal angle, opens the anal canal, and reduces anal canal resistance to ease stool evacuation.[46] Thus, standing or hovering over the toilet could lead to excessive straining during BMs and could contribute to the development of DD.

Other toileting habits may contribute to the development of concomitant female pelvic-floor disorders. In one study, excessive straining with BMs as a young adult was found to be more common among women with pelvic organ prolapse (61%) and women with urinary incontinence (30%) compared with controls (4%). In addition, 95% of the women with pelvic organ prolapse reported a current history of constipation compared with 11% of controls.[47] The relationships between excessive straining/constipation and other pelvic symptoms further illustrate the importance of toileting habit education. Other toilet habits, including failure to respond to the urge to defecate (too busy) or choosing to wait (until in the privacy of the home), are important to identify and to discuss with the patient. These habits can lead to stool retropulsion and worsening of the patient's condition.

The care of people with functional constipation requires a clinician who is knowledgeable and skilled in the diagnosis and management of a wide range of motor coordination, musculoskeletal, and movement impairments that may contribute to the underlying pathophysiology of this condition. Individuals with functional constipation will need to be taught the proper mechanics to expel stool. Other behaviors, including eating, fluid intake, and exercise, should be examined, evaluated, and managed with respect to their unique contribution to each patient's symptom cluster. Physical therapists are well suited with regard to the examination, diagnostic, and intervention skills, including those to reduce risk factors, necessary to treat patients with functional constipation.

History/Symptoms and Quality-of-Life Assessment

As mentioned previously, Rome III criteria for diagnosing functional constipation must include any 2 of the symptoms listed earlier. In addition, Appendix 1 provides other pertinent questions to clarify symptoms and behaviors that may affect bowel function.[48,49] The Bristol Stool Form Scale,[50] a self-report tool for adults with functional gastrointestinal disorders, can be used to obtain stool form information. This tool has been shown to have a moderate correlation with colonic transit time, but not stool frequency, in adults with constipation.[51]

Past and current medical and surgical history, medications, and risk factor assessment for constipation should be queried. Lindberg et al[52] provided an extensive list of possible causes and constipation-associated conditions. In women, it has been suggested that sexual and physical abuse history be elicited based on studies that showed an alarming percentage of women with constipation reported abuse.[48] Screening for "red flags" is important to determine whether the patient's symptoms are characteristic of functional constipation amenable to physical therapy interventions or of more serious conditions requiring refer-

ral to a physician. Suggested red flags are listed in Appendix 1.[48,52,53]

If a patient has difficulty fully describing bowel and coexisting pelvic symptoms, pelvic symptom severity, and quality-of-life and disability impact, several questionnaires are available to the physical therapist to obtain this information. These questionnaires can be used to assist the physical therapist in identifying the scope and impact of pelvic-floor dysfunction. In addition, these questionnaires are excellent measurement tools to determine intervention outcomes, as they have been extensively tested and recommended based on their psychometric properties. For symptoms and symptom severity, the Patient Assessment of Constipation–Symptom questionnaire[54] and the Constipation Severity Index[55] have been recommended.[56–58] The Patient Assessment of Constipation–Quality of Life[59–62] and Constipation-Related Quality of Life[63] questionnaires have been endorsed as excellent tools for measuring quality of life. The Constipation-Related Disability Scale may be useful to measure the extent of disability caused by constipation.[64] Due to the high co-occurrence (50%–80%) of coexisting pelvic-floor disorders (urinary incontinence, fecal incontinence, pelvic organ prolapse, pelvic pain) and their potential to cause patient distress and reduced quality of life, we suggest using the Pelvic Floor Distress Inventory-Short Form-20 and the Pelvic Floor Impact Questionnaire, as they have been shown to be reliable and valid measures.[65–67]

If the patient has been referred by a physician, it is important to ask whether a digital rectal examination or other diagnostic tests were performed. Digital rectal examination can identify a tear in the anal canal (anal fissure), creating excruciating pain with gentle palpation; polyps or masses; or rectal prolapse and is highly predictive for obstructive defecation.[48,68] Blood testing, colonoscopy, or endoscopy is not routinely performed unless the physician suspects organic disease and the patient reports alarm symptoms.[22,52] However, tests for anorectal function, including balloon expulsion and anorectal manometry, may be performed. Balloon expulsion is a simple test to identify abnormal defecation patterns. It requires the patient to expel an artificial stool; often used is a water- or air-filled medical-grade balloon attached to a catheter with a 3-way stopcock and syringe to alter balloon pressures. However, test procedures lack standardization, and although the inability to expel the balloon suggests DD, a normal test does not exclude DD.[48] Anorectal manometry measures pressure activity in the anorectum and provides information including rectoanal reflexes, rectal sensation (hypersensitivity or hyposensitivity), rectal compliance, and the ability to generate adequate intra-abdominal force to expel stool along with contraction versus relaxation of the EAS and PR-LA. Like balloon expulsion, this test lacks standardization, yet is judged as having good evidence in favor of the test to identify DD, rectal hyposensitivity or hypersensitivity, and impaired compliance.[48]

Colonic transit studies assess the speed that stool moves through the colon. There are several methods (radiopaque marker test, radioisotopes and scintigraphy, and wireless motility capsule) that can be used to measure colonic transit. Generally, depending on the site that markers accumulate, these tests can determine whether the patient has total or segmental colonic slow transit.[56] However, these tests also have been judged to lack standardization of methods and, particularly in the case of the wireless motility capsule, can be expensive and time-consuming to administer.[48,65] Colonic transit studies can have less utility in the presence of DD, as proximal colon function is commonly inhibited by evacuation disorders.[27,69] If these tests were not performed prior to physical therapy referral, the following situations may merit referral for anorectal testing and evaluation by a gastroenterologist: indeterminate physical therapist diagnosis and poor patient response to physical therapy intervention for a definitive physical therapist diagnosis.

Examination

If symptoms of functional constipation are identified by the physical therapist via the patient history or systems review, a physical therapist examination that includes a general neuromuscular screening, as well as specific thoracoabdominal,[48,70,71] lumbopelvic and hip, perineal and intrapelvic, and neurologic examinations, should be performed.[72–80] Appendix 2 specifies elements of the physical therapist examination for functional constipation disorders and associated impairments and their relationship to constipation symptoms to assist in physical therapist diagnosis. Elements of this examination that can be performed by the generalist physical therapist are noted in Appendix 2.

The thoracoabdominal examination should highlight respiration, particularly diaphragmatic excursion, as it is often impaired in people with chronic low back pain or sacroiliac joint impairment.[76,77,81] Thoracic spine and rib mobility and static and dynamic postural habits are important to examine, as they can affect chest wall kinematics and breathing patterns[82] essential to intra-abdominal force production required to effectively expel stool. A screen of the lumbar spine, pelvic ring, hip joints, and core stabilizers will identify impairments that might impede proper toilet positioning.[77] Assessment of myofascial tissues from T10 to thighs, including perineal and intrapelvic structures, will identify soft tissue impairments potentially affecting motor coordination.[72,76]

Intervention

It is important for the physical therapist to accurately diagnose functional constipation type to guide intervention decisions. Commonly, patients will be referred for physical therapy with an unspecified constipation diagnosis. Also, a patient being treated for other issues may have concomitant constipation in need of physical therapy intervention. Such patients may not know or recall the underlying cause for their symptoms or be able to provide a full history of symptoms and symptom impact. In this case, a physical therapist without specialized knowledge may attempt to treat the patient based on a nonspecific diagnosis or fail to refer the patient to the appropriate health care professional. Appendix 3 provides recommendations for referral to the appropriate health care professional based on specific symptoms.

Patients with constipation of differing etiology experience the same end results: difficulty with stool expulsion and similar life role impact. The disablement process associated with STC versus DD constipation type is illustrated in eFigure 1 (available online) using the *International Classification of Functioning, Disability and Health* (ICF) model.[83] Despite differences in body structure and function, eFigure 1 shows how the impact on activity and participation and the influences of environmental and personal factors can be similar regardless of constipation diagnosis. However, because etiology for STC and DD differs, interventions aimed toward reducing changes in body structure and function need to be specific to constipation type, as described in the following cases.

Patient A

Patient A (STC type) is a 25-year-old woman (weight: 56.7 kg [125 lb], height: 167.6 cm [5 ft 6 in]) who reports infrequent urges to defecate, abdominal pain, and abdominal distension that began about 2 years previously but have worsened over time. She notes her inability to sense the urge to defecate following ingestion of a meal in the past 6 months. When she is able to defecate, she produces only small, separate, hard lumpy stools (Bristol Stool Form Scale type 2). Her colonic transit study demonstrated evidence of diffuse marker representation throughout the colon consistent with STC. Her social history revealed she has been employed as an elementary school teacher for the past 2 years. She admits to regularly skipping lunch and restricting her fluid intake to avoid having to empty her bladder and bowels at work. Because of her job responsibilities, she has little time to use the toilet. She uses public toilets only when she "can no longer hold it" because she fears coming in contact with germs. When she does use a public restroom, she will not sit, but hovers over the toilet. Her inability to defecate has led to anxiety (fear of not being able to have a BM) and depression (friends no longer invite her to dinner, as she has declined numerous invitations because eating increases her abdominal discomfort). Because of her changed social life, she spends evenings and weekends reading books and watching television. Physical therapist examination findings and interventions for patient A are listed in Appendix 4.

Interventions for patient A (see Appendix 4), including abdominal massage and lifestyle factor education and recommendations, are aimed at speeding movement of stool through the colon. Of these interventions, lifestyle education can be provided by the generalist physical therapist. Although lifestyle factor intervention can affect patient symptoms, additional intervention from a physical therapist specializing in pelvic-floor dysfunction may be necessary to obtain the best patient outcome.

Abdominal (colonic) massage is a noninvasive intervention for constipation management. Although exact mechanisms underlying its effects are not entirely clear, it is thought to stimulate peristalsis, decrease colonic transit time, and increase BM frequency.[84] Positive outcomes associated with this intervention in people with constipation have been described in single-case reports and a small number of randomized trials.[85–89]

Although there is growing evidence to support the use of abdominal massage in the management of constipation, intervention parameters are not standardized.[85,88,89] In particular, the described massage form varies from light stroking[89] or kneading[84] alone to a combination of forms (stroking, effleurage, kneading, and vibration).[88] The massage typically starts at the base of the retroperitoneal ascending colon (right anterior iliac spine) and proceeds upward and in a clockwise direction across the intraperitoneal transverse colon, then downward over the descending colon (retroperitoneal in most patients) to the left anterior iliac spine and finally to the left ischium. The procedure is performed at a rate that takes 1 minute to complete and is repeated 10 times per session (eFig. 2, available at academic.oup.com/ptj). The procedure can easily be taught, thus empowering patients to manage their symptoms in both the short and long term. Acknowledged contraindications include bowel obstruction, abdominal mass, inflammatory intestinal disease, unstable spine, recent abdominal scarring, skin lesions, spastic colon due to irritable bowel syndrome, and recent radiation therapy (within 6 weeks).[88–91] However, associated side effects are unknown.[85,88]

Education related to toileting habits is important in this case for several reasons. First, failing to respond to the urge to defecate could be a factor contributing to constipation. If defecation is delayed, colonic and rectal contractions that propel stool and the sensation of urgency subside as the rectum accommodates to continued distension.[92] Stool retained in the colon will become hardened,[93] making it more difficult to expel at a later time. Second, hovering or standing over public toilets and poor toilet sitting posture will make expelling stools difficult or impossible. As mentioned previously, a posture of increased hip flexion facilitates defecation and reduces the need to strain.[46] This patient would be instructed to place a stool under her feet while sitting on the toilet to simulate the squat position. Third, it is important to assure patients that the normal defecatory frequency ranges from 3 times per day to 3 times per week.[3] If a daily BM is expected and does not occur, the patient may become anxious and spend much of the day in the bathroom, straining excessively to produce stool.

A history positive for poor dietary choices, eating habits, and fluid intake would necessitate patient education or a referral to another health care provider to reduce their impact on patient A's bowel function. Poor diet (inadequate caloric, fiber, and fluid intake) and stool consistency (small, low-weight, and hard stools) are associated with slow colonic transit and difficult evacuation.[15,94] Alternately, diets containing sufficient fiber produce bulky, soft stools that move through the gut quickly.[95] The Academy of Nutrition and Dietetics recommends fiber intake of 14 g of total fiber per 1,000 kcal consumed (ranging from 21 to 25 g for women aged 19–70 years who are not pregnant and not lactating and ranging from 30 to 38 g for adult men aged 19–70 years).[96] These recommendations are based on levels protective against coronary heart disease. The Academy of Nutrition and Dietetics also rec-

Figure 2.
Defecatory process.[107–112] The defecatory process begins with rectal distension eliciting a series of reflexes ending in the expulsion of stool. RAIR=rectoanal inhibitory reflex, IAS=internal anal sphincter, EAS=external anal sphincter, SR=sampling reflex, IAP=intra-abdominal pressure, CR=closing reflex, PR=puborectalis.

ommends that fiber be obtained through plant foods, not supplements.[96] It is important to note that 90% of American children and adults do not meet daily fiber recommendations.[97] Also key is the finding that people with STC do not respond well to fiber intake ≥30 g per day.[37] Therefore, if patient A's dietary history includes meals that are infrequent, small, and seemingly fiber deficient, a referral to a dietitian should be made, as dietary intervention is important in this patient's plan of care.

Because fiber combines with water and ions in the colon,[98] monitoring of patient A's fluid intake is warranted. Data from a large epidemiologic study that examined the association between fiber and liquid intake to constipation showed low liquid intake alone to be a predictor of constipation in women.[99] There is limited evidence that increasing fluid beyond the daily (24-hour) recommended amount (approximately 2.7 L for women and 3.7 L for men ≥19 years of age)[100] will improve constipation.[101] In addition, a general recommendation to increase fluids could have a deleterious effect in patients with coexisting bladder symptoms (urinary frequency and nocturia).[102] Likewise, increasing fluid intake in older individuals with certain comorbid conditions (cardiac and renal disease) may be contraindicated.[9]

Finally, a recommendation to increase patient A's physical activity level may be indicated, as physical inactivity has been identified as a risk factor for constipation.[15] However, few studies have examined the effect of physical exercise on colonic transit and symptoms in people with functional constipation. Based on this limited evidence, one review concluded that physical exercise is more likely to be beneficial in people with lack of exercise.[103] Any exercise recommendation targeted toward improving colonic transit also needs to consider the impact of exercise intensity. Low-intensity exercise may increase or have no effect on gastric emptying, whereas high-intensity exercise may delay gastric emptying.[104]

Patient B

Patient B (DD type) is a 52-year-old woman who reports infrequent BMs, the need to strain excessively with every BM, a sense of incomplete emptying often following a BM, and the need to digitally evacuate stools occasionally. She inconsistently recognizes the urge to defecate. Her symptoms began after the delivery of her third child (at age 39 years), worsening over the past decade. She discussed her symptoms with her primary care provider and was referred to a gastroenterologist, who recommended an increase in fluid and fiber intake and prescribed a laxative. Despite years of following this regimen, her awareness of and capacity to expel stool did not improve. When previously employed as a cosmetic salesperson, she was permitted to leave her counter only during scheduled breaks. This situation caused her to experience hard, lumpy stools and painful BMs. As a result, she quit her job, and her attention over the past several years has been highly focused on having a BM. Her sexual relationship with her husband also has been impeded by discomfort caused by constipation. Because of the social impact of her symptoms, she has become depressed and feels hopeless. Examination findings and interventions for patient B are listed in Appendix 4.

For patient B (DD type), physical therapy interventions are intended to teach skills and behaviors to promote the defecation process, including sensing stool entering the rectum, determining consistency of rectal contents (liquid, solid, or gas) in the sensate proximal anus, responding to the urge to defecate, sitting with optimal toileting posture, and coordinating relaxation of the EAS and PR-LA while the diaphragm and abdominal wall muscles generate sufficient intra-abdominal pressure assisting in stool expulsion (Fig. 2).[34,105–112] Specific physical therapy interventions for this patient include rectal sensory retraining; myofascial release to restricted tissues; muscle strengthening and retraining (abdominal wall, diaphragm, PR-LA, and EAS); abdominal, diaphragmatic, EAS, and PR-LA muscle coordination specific to defecation; and patient education to improve self-management of symptoms.[26,32–35] Because of the multifaceted nature of DD, administering these interventions at the optimal time and intensity during the course of physical therapy treatment requires advanced training and skill and thus is best provided by a physical therapist specialist in pelvic-floor dysfunction.

Normally, as stool distends the rectal wall, pressure receptors activate the rectoanal inhibitory reflex, resulting in internal anal sphincter relaxation and EAS contraction (Fig. 2).[107–112] The EAS remains active to prevent fecal incontinence, as the sampling reflex allows stool to enter the upper anus where stool consistency (liquid, solid, gas) is determined.[113] As patient B has poor detection of stool entering the rectum, balloon catheter retraining is indicated to enhance rectal sensory awareness. The balloon catheter is inserted into the rectum and filled with air or water until the patient senses pressure. As her recognition of rectal pressure improves, the balloon is filled in smaller increments to further challenge her ability to sense

lower rectal pressures.[108] This procedure has been found effective at reducing rectal hyposensitivity in 70% of patients.[3,114,115] As her rectal sensory awareness improves further, retraining of the defecatory process is initiated. This patient is advised to recognize and respond at the first urge to defecate (typically upon waking and following meals[9]) using proper toilet posture, sufficient intra-abdominal force, and timely coordination between the EAS and PR-LA at each phase of the defecation process.[46]

During distinct phases of stool expulsion, the PR-LA and EAS act in parallel or independently to coordinate expulsion. If patient B's constipation also is attributed to a failure to relax the PR-LA and EAS during various phases of stool expulsion, internal rectal or vaginal palpation is recommended to train the process of PR-LA and EAS relaxation during bearing down to propel stool caudally.[74] If the patient is still unable to perform this skill, other forms of biofeedback can be used to promote motor learning.

The benefits of instrumented biofeedback training to promote coordinated relaxation of EAS and PR-LA during straining to defecate are well described in the literature.[116,117] Three controlled trials showed biofeedback therapy to be superior in the management of dyssynergic defecation compared with polyethylene glycol,[118] sham feedback,[119] and diazepam.[117] Biofeedback training for short- and long-term management of dyssynergic defecation has been given a level 1, grade A recommendation.[120] Short-term management of levator ani syndrome (nonrelaxing muscle) with dyssynergic defecation using biofeedback has been given a level II, grade B recommendation.[120] However, to promote coordination between abdominal wall muscle activation and PR-LA and EAS relaxation required for stool expulsion, verbal training alone or verbal training supplemented by instrumented biofeedback is equally effective in promoting motor learning.[4] Despite this evidence, there continues to be a dependence on instrumented biofeedback training to treat people with DD. As a result, other neuromuscular impairments contributing to dyssynergia may be ignored. This problem is perpetuated by a lack of awareness in the medical community regarding the availability of physical therapists with expertise in pelvic-floor dysfunction to treat people with DD.[3,121] Regardless of delivery method, augmented feedback should be reduced in frequency over time, allowing the patient to develop self-awareness of correct PR-LA and EAS contraction and relaxation.[76]

If patient B is still unable to defecate following motor coordination training, myofascial restriction or trigger points in the PR-LA and EAS also may be contributing to DD. The medical community has historically managed DD by invasive procedures with varying associated risks, including injections (botulinum toxin or steroid with local anesthetic) and surgical myotomy.[30,122,123] Alternatively, myofascial release, a noninvasive, low-risk intervention is used to address myofascial impairments located between the umbilicus and thighs.[124] Evidence supporting use of this intervention for people with constipation is lacking. However, one multicenter randomized controlled trial of women with interstitial cystitis or painful bladder syndrome and PR-LA and EAS tenderness to palpation showed that 59% of the women assigned to the myofascial release intervention obtained moderate or marked improvement compared with 26% of those who received general massage.[125] If intravaginal or intrarectal myofascial release provided short-term improvement in volitional muscle relaxation, patient B will be instructed in self-administered myofascial release using a Food and Drug Administration–approved intrapelvic trigger point wand. Anderson et al[126] found no adverse events following self-management of trigger points using this type of device 2 to 4 times per week in people with chronic pelvic pain.

Finally, if patient B is still unable to expel stool, it may be due to ineffective recto-abdominal wall reflex activation. This reflex assists rectal peristaltic contractions in pushing stools toward the anus.[106] Weak or uncoordinated abdominal wall muscles or impaired diaphragm excursion may impede this reflex from generating sufficient intra-abdominal pressures.[127,128] The balloon catheter can be used to help the patient learn to generate these propulsive forces by instruction in diaphragmatic excursion[129,130] with coincident contraction of abdominal wall muscles, including the transversus abdominis,[128] external and internal oblique,[131] and rectus abdominis muscles.[35,105,106,128,132] While the patient attempts to expel the balloon, verbal cueing is provided to relax the PR-LA and EAS and to bear down with coordinated diaphragmatic excursion and abdominal wall activation. Gentle traction can be applied to the balloon by the physical therapist to assist the patient's expulsion efforts.[114] This procedure may improve patient B's ability to learn and execute the mechanics of defecation. Although specialist physical therapists use balloon catheters to provide feedback for both sensory retraining and muscle coordination, the origin of and evidence for their use are only documented in the medical literature.[35,106]

Summary

The purpose of this perspective article is to increase the knowledge base of physical therapists regarding functional constipation, including etiology, epidemiology, classification, and physical therapist management (including outside referral to other health professionals). Using the ICF model, we illustrated how patients with STC and DD may experience similar impact at the activity and participation levels, yet etiology and impairments underlying their conditions differ. Although physical therapist management for STC and DD can overlap, distinctly different interventions were presented through 2 patient examples. Through these examples, we acknowledged areas where evidence to support certain interventions is limited, indicating areas of needed research. However, it is our perspective that physical therapist management can be an effective first-line intervention for individuals with functional constipation. Key points from this perspective article are presented in Appendix 5.

Both authors provided concept/idea/project design and writing. Dr Borello-France provided project management and consultation

(including review of manuscript before submission).

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DOI: 10.2522/ptj.20160110

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Appendix 1.

Pertinent Questions to Ask When Obtaining a History to Clarify Patients' Symptoms and Behaviors That May Affect Bowel Function[3,15,20,21,26,32,35,44,48–51,94] and Red Flag Conditions for Constipation[48,52,53,79]

Pertinent Questions to Ask When Obtaining a History to Clarify Patients' Symptoms and Behaviors That May Affect Bowel Function

- How many bowel movements do you have a day, week?
  - Implications: Normal bowel movement frequency is 3 times/d to 3 times/wk. Elderly individuals often "feel constipated" if they fail to defecate daily.
- How much fluid do you drink per day?
  - Implications: Identify extremes in inadequate or excessive fluid intake. Patients may have coexisting bladder symptoms or comorbidities mandating volume of fluid intake.
- Number, frequency, and content of meals.
  - Implications: Consider fluid and fiber content in foods. Infrequent and small meals may slow transit time.
- What is your favored toilet position?
  - Implications: Sitting with knees higher than hips is optimal. Hovering over the toilet may interfere with pelvic-floor muscle relaxation, leading to excessive straining. Leaning forward or backward may affect ease of defecation.
- Do you feel a sense of urgency to defecate? If yes, do you respond to the urge by going to the toilet, or do you suppress the urge to defecate at a later time?
  - Implications: May indicate the need to educate in why urge suppression is problematic.
- Do you feel the need to use digital maneuvers, enemas, laxatives, or stool softeners to evacuate?
  - Implications: May indicate a functional bowel disorder.
- Do you tend to have large bowel movements that clog the toilet?
  - Implications: Rectal hyposensitivity or deferring the call to stool may be implicated.
- What does your stool look like, typically? Have patient look at Bristol Stool Form Scale.
  - Implications: Stool types 1 and 2 on the Bristol Stool Form Scale chart correlate with slowed transit time.
- How long does it generally take for you to produce a stool once on the toilet?
  - Implications: Habitual sitting on the toilet for longer periods of time may not be conducive to effective defecatory practices.

Red Flag Conditions for Constipation

- Bleeding from the anus[a]
- Recent onset of constipation or worsening of constipation
- Onset >50 years of age with no diagnostic screening for colon cancer
- Weight loss
- Anemia
- Blood in stools
- Change in appearance of stools
- Obstructive symptoms (intractable anal blockage with severe abdominal pain)
- Abdominal mass
- Fever
- Anorexia
- Nausea
- Vomiting
- Family history of colon cancer or inflammatory bowel disease

[a] Bright red blood in the stool may indicate pathology in the lower gastrointestinal tract, most commonly from the descending colon to the anorectal region. Black tarry stools that are sticky and shiny may indicate bleeding from the upper gastrointestinal tract, most commonly from the esophagus, stomach, and duodenum. Black tarry stools may indicate a serious medical condition, whereas black nontarry stools can appear as a side effect of ingestion of medicines or supplements (iron and bismuth salts, in particular) or ingestion of certain foods (black licorice or beets).

Appendix 2.

Elements of the Physical Therapist Examination for Functional Constipation Disorders[a]

Thoracoabdominal Examination[34,48,69–71,81,105,124,b]

- Bearing down: common impairments
  - Ineffective intra-abdominal force production may be identified as excessive outward bulging of the abdomen, weak or absent palpable abdominal muscle contraction, and observation of poor diaphragmatic excursion
  - Excessive intra-abdominal force production evidenced by Valsalva maneuver
- Diaphragmatic breathing
  - Limited diaphragmatic excursion may contribute to reduced intra-abdominal force production with bearing down
- Abdominal strength
  - Weakness of abdominal muscles may contribute to reduced intra-abdominal force production while bearing down
- Abdominal palpation
  - Abdominal distension and palpable stool may indicate STC
  - Diastasis recti may be evidence of impaired intra-abdominal pressure regulation
  - Abdominal wall tenderness/spasm may indicate habitual abdominal wall tension, constipation-dominant irritable bowel syndrome, or chronic stool in multiple segments of the colon
- Thoracic and rib mobility
  - Stiffness may impede diaphragmatic excursion and reduce intra-abdominal forces, which are required to expel stool
- Posture
  - Flexed posture may impede diaphragmatic excursion and reduce intra-abdominal forces, which are required to expel stool

Lumbopelvic and Hip Examination[71,75,76,126,b]

- Musculoskeletal screen of the lumbopelvic and hip regions
  - May effect the defecatory process by convergence of visceral and somatic inputs to the spinal cord
  - May impede proper toilet positioning

Perineal and Intrapelvic Examination[35,67,71–78,81]

- Visual inspection of perineum
  - Skin excoriation, external hemorrhoids, rectal prolapse (rectal intussusception), anal fissures, and skin tags
    - May be indicative of disordered defecation
    - Skin tags also can be associated with inflammatory bowel disease
  - Anus should be closed, not gaping
    - Gaping is an indication of muscle weakness or pudendal nerve damage
- Observation of bearing down as if defecating: normal perineal descent is 1–3.5 cm
  - $<$1 cm of descent may indicate poor bearing-down effort or pelvic muscle spasm
  - $>$3.5 cm of descent may indicate excessive bearing down and places the patient at risk for pudendal nerve injury
  - Supine or side-lying position is more convenient for the examiner; however, sitting is the functionally relevant testing position
- Internal rectal examination
  - Presence of internal hemorrhoids, rectocele, or rectal prolapse may be indicative of excessive bearing down and may cause obstruction
- Stool in the rectum
  - May indicate a defecation disorder or conscious choice to postpone defecation
  - Impaired awareness may indicate rectal hyposensitivity
  - Ineffective propulsive forces while bearing down
- Internal anal sphincter integrity
  - Internal anal sphincter is responsible for 70%–80% of anorectal resting tone; IAS damage may impair stool retention
- External anal sphincter and PR-LA: assess voluntary contraction, voluntary and complete relaxation (coordination), contraction endurance, and presence of muscle tension/TP
  - Patient unable to fully relax muscle following contraction may indicate DD
  - Inadequate muscle force and endurance impede timely contraction and relaxation of the EAS and PR-LA necessary to allow stool progression from the rectum to the anus to complete defecation
  - Extrapelvic muscle activation (gluteals, adductors, or abdominals) is indication of poor motor coordination
  - Palpation of nonrelaxing PR-LA and EAS or TPs in these muscles may indicate muscle weakness, pain, or incoordination
- Bear down as if defecating
  - External anal sphincter or PR-LA contraction, rather than relaxation, may indicate muscle incoordination or nonrelaxing PR/EAS, as noted above. Optimally assessed while the patient is sitting via digital palpation or electromyographic biofeedback

Neurologic Examination[79,b]

- Perineal sensation S2–S5 and anocutaneous reflex
  - Impairment indicates neurogenic involvement

[a] EAS=external anal sphincter, STC=slow transit constipation, IBS-C=irritable bowel syndrome with constipation, PR-LA=puborectalis portion of the levator ani muscle, IAS=internal anal sphincter, TP=trigger points, DD=disordered defecation.
[b] Examination procedures within the scope of knowledge and skills of the generalist physical therapist.

Appendix 3.
Appropriate Physical Therapy Referral for Common Symptoms Present With Functional Constipation[a]

- Poor dietary management: dietetics
- Urinary incontinence: gynecology, urogynecology, urology
- Cystocele: gynecology, urogynecology, urology
- Severe pelvic pain: gynecology, urogynecology, urology
- Palpable sutures or mesh: colorectal surgery, gynecology, urogynecology
- Fecal incontinence: gastroenterology
- Enterocele or rectocele: colorectal surgery, gynecology, urogynecology
- Rectal prolapse: colorectal surgery
- Hemorrhoids or anal fissure: colorectal surgery, gastroenterology
- Anorectal mass or other undefined structure: colorectal surgery, gastroenterology
- Undiagnosed rectal bleeding: colorectal surgery, gastroenterology
- Severe abdominal pain, bloating, or distension: colorectal surgery, emergency medicine, gastroenterology
- Prolonged vomiting: colorectal surgery, emergency medicine, gastroenterology
- Severe inability to defecate: colorectal surgery, emergency medicine, gastroenterology
- Saddle anesthesia: neurology, orthopedic surgery
- Change in bowel habits: primary care physician
- Rapid, severe onset of any gastrointestinal symptom: emergency medicine
- Any symptom for which the physical therapist is unfamiliar: refer as indicated

[a] In some regions of the country, general surgery manages many types of potential surgical cases.

Appendix 4.
Examination Findings and Prescribed Interventions for Patients A (Slow Transit Constipation Type) and B (Disorder Defecation Type)

Patient A

- Musculoskeletal screen: negative
  - No sitting and standing postural faults
- Abdominal examination
  - Good abdominal muscle activation and diaphragmatic excursion by abdominal observation and palpation when patient is bearing down
  - Abdomen appears distended, confirmed by patient self-measurement changes of up to 4 cm in distension
  - Palpable stool in transverse and descending colon
- Perineal examination
  - Intact sensation
  - Absence of hemorrhoids, skin tags, or anal fissures
- Intravaginal examination
  - Absence of pelvic organ prolapse
  - Intact sensation to touch
  - Ability to coordinate a levator ani muscle contraction (examiner's fingers are elevated fully to pubic bone; strong levator ani muscle contraction is held for 8 s, and patient is able to fully relax the levator ani muscle contraction)
- Intrarectal examination
  - Absence of stool in the rectum
  - Absence of hemorrhoids
  - Strong EAS contraction followed by full EAS[a] relaxation
  - Strong levator ani muscle contraction followed by full levator ani muscle relaxation
  - Trigger points/myofascial restriction: absent
  - Upon bearing down, the patient demonstrates coordinated levator ani muscle and EAS relaxation and sufficient intra-abdominal force production, resulting in caudal movement of examiner's finger as if expelling stool
    - Normal perineal descent (2 cm) with bearing down

Prescribed Interventions:

- Abdominal massage
- Referral to dietitian to address dietary habits and fluid intake
- Moderate intensive exercise program
- Patient education
  - Lifestyle factor education, including toileting posture and habits
  - Self-abdominal massage

(Continued)

Appendix 4.
Continued

Patient B

- Musculoskeletal screen: negative
  - No observed sitting and standing postural faults or thoracocostal mobility impairments
- Abdominal examination:
  - Poor abdominal muscle activation and diaphragmatic excursion by abdominal observation and palpation when patient is bearing down
  - Abdominal muscle weakness: rectus abdominis, transversus abdominis, and internal and external obliques
- Perineal examination
  - Intact sensation
  - Absence of hemorrhoids, skin tags, or anal fissures
- Intravaginal examination
  - Absence of pelvic organ prolapse
  - Intact sensation to touch
  - Inability to coordinate levator ani muscle contraction (examiner's fingers are elevated fully to pubic bone; strong levator ani muscle contraction is held for 10 s, but patient is unable to fully relax levator ani muscle contraction)
- Intrarectal examination
  - No sensory awareness of stool in rectum (palpable upon rectal examination)
  - Absence of hemorrhoids
  - Strong EAS contraction followed by full EAS relaxation
  - Weak and painful levator ani muscle contraction followed by poor levator ani muscle relaxation
  - Trigger points/myofascial restriction: present in the levator ani muscle
  - Upon bearing down, the patient does not demonstrate coordinated levator ani muscle and EAS relaxation or sufficient intra-abdominal force as if expelling stool
    - Levator ani muscle and EAS contract resulting in cranial instead of caudal movement of the examiner's finger
    - Following levator ani muscle and EAS relaxation training, the examiner's finger still does not move caudally, indicating a lack of intraabdominal force production
    - Excessive perineal descent (4.5 cm) with bearing down

Prescribed Interventions:

- Rectal sensory retraining with balloon catheter biofeedback
- Myofascial release to restricted tissues
- Strengthening/retraining of abdominal wall, diaphragmatic, and pelvic-floor muscles
- Patient education
  - Lifestyle factor education, including toileting posture and habits
  - Abdominal wall, diaphragmatic, and pelvic-floor muscle coordination specific to defecation

[a] EAS=external anal sphincter.

Appendix 5.
Perspective on Adult Functional Constipation: Key Points to Consider[a]

- Constipation is a symptom-based disorder characterized by infrequent stools, difficulty with stool passage, or both.
- Constipation affects quality of life and may affect physical therapy outcomes.
- Functional constipation presents with impaired interactive physiology of related anatomical structures.
- Functional constipation is divided into 3 subgroups: normal transit constipation, slow transit constipation, and defecation disorders.
- Medical management focusing on the use of laxatives and fiber supplementation may fail to address the underlying pathophysiology contributing to DD or STC functional constipation.
- Physical therapists possess the knowledge and skills to diagnose and manage a wide range of neuromusculoskeletal impairments associated with DD and STC but also must consider when referral to a specialist is appropriate to assist in meeting physical therapy goals.
- Rome III critera, medical and surgical history, medical testing, and self-administered questionnaires can assist the physical therapist in determining the scope and impact of abdominopelvic dysfunction and in formulating a diagnosis.
- The generalist physical therapist can perform elements of examination and treatment for the patient experiencing STC, whereas the physical therapist specializing in pelvic-floor dysfunction generally possesses the knowledge and skills to perform both examination and treatment for patients with STC and DD.
- Different underlying pathology (STC vs DD) and associated changes in body structure and function can lead to similar activity limitations and participation restrictions.
- Slow transit constipation treatment strategies are aimed to speed movement of stool through the colon, including abdominal massage and lifestyle factor education and recommendations.
- Disordered defecation treatment strategies are intended to teach skills and behaviors to promote the defecation process, including sensing stool entering the rectum, determining consistency of rectal contents (liquid, solid, or gas) in the sensate proximal anus, responding to the urge to defecate, sitting with optimal toileting posture, and coordinating relaxation of the EAS and PR-LA while the diaphragm and abdominal wall muscles generate sufficient intra-abdominal pressure, assisting in stool expulsion.
- Physical therapist management can be an effective first-line intervention for individuals with functional constipation.

[a] DD=disordered defecation, STC=slow transit constipation, EAS=external anal sphincter, PR-LA=puborectalis portion of the levator ani muscle.