

**EVALUACIÓN DE LOS HÁBITOS ALIMENTARIOS
E INGESTA NUTRICIONAL
EN LA POBLACIÓN ADULTA DE LES ILLES BALEARS**



Tesis Doctoral

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*El hombre encuentra a Dios detrás de cada puerta
que la ciencia logra abrir.
Albert Einstein*

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en la población adulta de les Illes Balears

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Con el beneplácito del Director

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Abreviaturas

VAN	Vigilancia Alimentaria y Nutricional
FAO	Organización de la Naciones Unidas para la Alimentación y la Agricultura
OCDE	Organización para la Cooperación y Desarrollo Económico
BIA	Análisis por Impedancia Bioeléctrica
IMC	Índice de Masa Corporal
ECV	Enfermedades Cardiovasculares
ENIB	Encuesta de Nutrición de las Islas Baleares (1999-2000)
INE	Instituto Nacional de Estadística
MAPA	Ministerio de Agricultura, Pesca y Alimentación
EINUT-I	Encuesta Nutricional del País Vasco (1990)
ENCAT	Encuesta de Nutrición de Cataluña
OBEX	Encuesta de Nutrición: Obesidad y estrés oxidativo (2009-10)
SENC	Sociedad Española de Nutrición Comunitaria
OMS	Organización Mundial de la Salud
AGS	Ácidos Grasos Saturados
AGM	Ácidos Grasos Monoinsaturados
AGP	Ácidos Grasos Poliinsaturados
PAL	Nivel de Actividad Física
DHA	Ácido Decosahexaenoico
DQI	Índice de Calidad de la Dieta
DQI-I	Índice de Calidad de la Dieta-Internacional
HEI	Índice de alimentación Saludable
HDI	Indicador de la dieta Saludable
DQS	La Dieta de Calidad
MDS	Adherencia a la Dieta Mediterránea
USDA	Departamento de Agricultura de los Estados Unidos
SoFAAS	Calorías de grasa sólida + bebidas alcohólicas + azúcares Añadidos
F y V	Frutas y Vegetales.
IBESTAT	Instituto de Estadística de las Islas Baleares
FFQ	Cuestionario de Frecuencia de Consumo de Alimentos
IDR	Ingesta Dietética Recomendada
TAS	Tensión Arterial Sistólica

TAD	Tensión Arterial Diastólica
SEM	Error Standard de la Media
RDS	Raciones Diarias Recomendadas

Abbreviations

FAO	Food and Agriculture Organization of the United Nations
BIA	Bioelectrical Impedance Analysis
BMI	Body Mass Index
WHO	World Health Organization
SFA	Saturated Fatty Acids
MUFA	Monounsaturated Fatty Acids
PUFA	Polyunsaturated Fatty Acids
PAL	Physical Activity Level
DHA	Docosahexaenoic acid
DQI	Diet Quality Index
DQI-I	Diet Quality Index-International
HEI	Healthy Eating Index
HDI	The Healthy Food Index
DQS	Diet Quality Score
MDS	Mediterranean Diet Score
USDA	U.S. Department of Agriculture
SoFAAS	Calories from solid fat+calories from alcohol+calories from added sugar.
FFQ	Food Frequency Questionnaire
RDI	Recommended Dietary Intake
SEM	Standard Error of Mean
RDS	Recommended Daily Serving



Evaluación de los hábitos alimentarios e ingesta nutricional en la población adulta de les Illes Balears, España

RESUMEN

Tesis Doctoral. Rogelio Salas García. Grup de Recerca en Nutrició Comunitaria i Estrés Oxidatiu, Departament de Biologia Fonamental i Ciències de la Salut, Universitat de les Illes Balears, (UIB), Palma de Mallorca, España.

Las encuestas nutricionales son una herramienta de gran utilidad para monitorear el estado nutricional de una población o grupos seleccionados; este proceso permite evaluar el consumo de alimentos, identificar grupos en riesgo, predecir tendencias y evaluar intervenciones, aportando información fiable a los responsables de establecer políticas alimentarias y definir prioridades en la intervención nutricional.

Los estudios epidemiológicos que han sido desarrollados con antelación, nos han dejado claro la relación entre hábitos alimentarios y salud, así como el importante rol que juegan los nutrientes en ciertas enfermedades, principalmente en los países desarrollados donde la incidencia de obesidad y enfermedades asociadas es cada vez mayor.

En España, además de la información respecto a disponibilidad alimentaria que aporta el Instituto Nacional de Estadística (INE) y el Ministerio de Agricultura Pesca y Alimentación (MAPA); se han desarrollado también otras encuestas nutricionales en diferentes comunidades autónomas donde la evaluación nutricional además de tener en cuenta la ingesta de alimentos, también han incluido evaluación antropométrica y marcadores bioquímicos. Tal es el caso de Las Illes Balears, que en los años 1999 - 2000 desarrolló la primera encuesta de nutrición (ENIB). En este estudio se pudo demostrar que la prevalencia de obesidad fue inferior a la media estatal y que el modelo alimentario de la población era típicamente mediterráneo aunque con algunas particularidades, principalmente el riesgo de ingestas inadecuadas. En este modelo de alimentación destacaba el consumo elevado de frutas, verduras y frutos secos, el uso casi exclusivo de aceite de oliva y el elevado consumo de leche de vaca, un consumo moderado de carnes rojas y alto de pollo y cerdo, pero menor la ingesta de legumbres, patatas, cereales y huevo que en otras regiones de España.

Diez años después y contando ya con el desarrollo de políticas alimentarias como los objetivos nutricionales y las guías alimentarias definidas por La Sociedad Española de Nutrición Comunitaria (SENC), la segunda encuesta de nutrición (OBEX 2009-2010), reveló los cambios en los hábitos alimentarios de las Illes Balears, los cuales difieren de la tradicional dieta mediterránea y que tienen similitud con los observados en el mundo y otras regiones de España. Así, la baja ingesta de frutas, verduras, huevo y leguminosas son evidentes. Además, la población más joven mostró una clara predilección por un mayor consumo de carne, leche y derivados, aceites y grasas, patatas, cereales, azúcar, bollería y bebidas azucaradas. Estos cambios indican hábitos alimentarios inadecuados en la población adulta de Baleares, reflejados en una baja calidad de la dieta de acuerdo al Índice de Calidad de la Dieta – Internacional (DQI-I) y al Índice de Alimentación Saludable (HEI).

Una coordinación intersectorial para la evaluación de políticas y estrategias en alimentación, principalmente en educación en salud y nutrición de la población, son indispensables para salvaguardar la permanencia de la tradicional dieta mediterránea en las Illes Balears.

LISTA DE MANUSCRITOS

- I. Rogelio Salas, Maria del Mar Bibiloni, Maria Elisa Zapata, Josep Lluís Coll, Antoni Pons, Josep A. Tur.

Current food consumption habits among the Balearic Islands adult population.

- II. Rogelio Salas, Maria del Mar Bibiloni, Josep Lluís Coll, Antoni Pons, Josep A. Tur.

Patterns of food consumption current of the adult population of the Balearic Islands. Does it comply with dietary guidelines WHO / FAO?

- III. Rogelio Salas, Maria del Mar Bibiloni, Josep Lluís Coll, Antoni Pons, Josep A. Tur.

Changes in food consumption patterns in the adult population of the Balearic Island (1999 – 2010): A comparison with the nutritional objectives for the Spanish population.

- IV. Rogelio Salas, Maria del Mar Bibiloni, Josep Lluís Coll, Antoni Pons, Josep A. Tur.

Diet Quality of adult population of Balearic Island evaluated by a Mediterranean adaptation of the Diet Quality Index-International (DQI-I) and Healthy Eating Index (HEI).

- V. Rogelio Salas, Maria del Mar Bibiloni, Josep Lluís Coll, Antoni Pons, Josep A. Tur.

Trends in energy and nutrient intake in adult population of Balearic Island, Spain (1999 – 2010).

- VI.** Rogelio Salas, Maria del Mar Bibiloni, Josep Lluís Coll, Antoni Pons, Josep A. Tur.

Trends of eating habits in the adult population of Balearics Islands, Spain (1999 – 2010).

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- VII. II World Congress of Public Health Nutrition**

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Food consumption patterns in the Balearic Islands adult population (2009-2010).

- VIII.** Zapata ME, Salas R, Bibilono MM, Llull R, Pons A, Tur JA.

Trends in food consumption in the Balearic Islands, Spain (1999 – 2010).

I. INTRODUCCIÓN



1. EPIDEMIOLOGIA NUTRICIONAL.

La epidemiología ha sido definida clásicamente como el estudio de los determinantes y la distribución de la frecuencia de enfermedades en poblaciones humanas. Es un instrumento aplicado a la salud pública y a la clínica, útil tanto en la planificación y evaluación de programas por parte del sanitario de la comunidad como en la toma de decisiones, la evaluación y el control de la calidad asistencial por parte del clínico.

La epidemiología en nutrición es una especialización de la epidemiología en general, pues el comportamiento de las variables nutricionales es mucho más complejo y difícil de medir, y requiere del apoyo de las ciencias relacionadas con la nutrición mucho más que en cualquier otro ámbito de la epidemiología (Michels, 2003).

La epidemiología nutricional tiene un ámbito de aplicación mucho más amplio que puede incluir: la descripción de las enfermedades carenciales, el estudio de las relaciones entre el consumo o no de determinados alimentos y la aparición de ciertas enfermedades, la investigación de tóxicos alimentarios, el análisis del papel de la nutrición en la etiopatogenia o la evolución de diversas enfermedades, el estudio de los factores socioeconómicos, culturales, agrícolas y fisiológicos condicionantes del acto alimentario, la evaluación de instrumentos de valoración de la ingesta alimentaria, la descripción del estado nutricional de una población, la evaluación de la eficacia o efectividad de un programa de intervención nutricional, etc.

La perspectiva de la epidemiología nutricional relaciona o hace convergir por un lado los factores que influyen en la disponibilidad y el consumo de alimentos, y por otro la expresión, en el concepto más amplio de la palabra, de la enfermedad (Hu, 2002; Kushi, 1994).

Existen diversos términos que se utilizan bajo el concepto de la vigilancia epidemiológica nutricional y que incluyen: Vigilancia nutricional, monitorización nutricional, encuesta nutricional o alimentaria y cribado nutricional. La información que forma parte de un sistema de vigilancia epidemiológica nutricional varía considerablemente en función del grado en el que se establezca el mismo (Willett, 1987; Kelemen, 2007).

En 1974 la Conferencia Mundial de la Alimentación celebrada en Roma se pronunció por el establecimiento de la vigilancia alimentaria y nutricional (VAN) como la única forma de desarrollar los sistemas de información relacionados con la nutrición con vistas a seleccionar y aplicar políticas y programas efectivos. Desde entonces se han propuesto muchas definiciones de vigilancia alimentaria y nutricional. En todas ellas ha quedado establecido de alguna forma que vigilancia alimentaria y nutricional es estar

atento a observar la nutrición para tomar decisiones que conduzcan al mejoramiento del estado nutricional de una población (Jerome & Ricci, 1977; Berg & Austin, 1984).

Esta definición tan amplia significa en la práctica: el monitoreo de la disponibilidad y el acceso a los alimentos para tratar de eliminar o minimizar los obstáculos que se encuentren a lo largo de la cadena alimentaria, conocer el consumo efectivo de alimentos por diferentes grupos poblacionales y el monitoreo del estado nutricional de aquellos grupos en riesgo para determinar dónde y cuándo existen los problemas y detectar quiénes son los grupos más afectados con el objetivo de establecer acciones. Vigilancia alimentaria y nutricional implica acción (de Haen & Thompson, 2003).

1.1. Objetivos de la epidemiología nutricional.

La investigación epidemiológica en nutrición tiene tres objetivos generales:

- Describir la distribución y magnitud de las enfermedades relacionadas con la nutrición y desequilibrios nutricionales y alimentarios en las poblaciones humanas.
- Elucidar las causas de las enfermedades relacionadas con la nutrición.
- Proporcionar la información necesaria para planificar y gestionar servicios y programas para la prevención, control y tratamiento de dichas enfermedades.

Desde el punto de vista evolutivo la vigilancia alimentaria y nutricional (VAN) ha contribuido a:

1. La evaluación de las estrategias nacionales sobre alimentación y nutrición.
2. La evaluación de los servicios locales de salud.
3. La definición y la formulación de políticas y programas nacionales de alimentación y nutrición.
4. Mantener actualizado el diagnóstico de la situación alimentaria y nutricional.
5. La elaboración de los perfiles nutricionales de los países.
6. Monitorear las metas de los planes nacionales de Acción para la Nutrición.
7. Priorizar áreas geográficas y líneas de acción e intervención de organismos nacionales e internacionales.

1.2. Tipos de estudios en epidemiología nutricional.

La epidemiología se sirve de muy diversos diseños para el estudio de la distribución y determinantes de los acontecimientos relacionados con la salud y la

enfermedad. La elección entre ellos depende básicamente de los objetivos del estudio, ya que cada uno de estos métodos posee ventajas y limitaciones.

Existen cinco diseños epidemiológicos básicos, todos ellos requieren el planteamiento de objetivos asequibles y coherentes, la selección de una población, un procedimiento para recoger la información y una estrategia para interpretar los datos. La elección entre diferentes alternativas dependerá, además de los objetivos, de la exposición y la enfermedad en estudio y el tiempo y los recursos disponibles, los diseños epidemiológicos son:

- a) **Estudios ecológicos o de correlación.** Su principal característica es que tanto la variable independiente (estado nutricional) como la variable dependiente (grado de enfermedad) no se determinan en individuos: sus unidades de observación son grupos de población. Su objetivo es medir el valor medio del factor que se cree causal (de riesgo o preventivo) y el acontecimiento de interés, y correlacionarlos en las poblaciones estudiadas (correlaciones ecológicas) o en una única población en momentos diferentes (correlaciones temporales).
- b) **Estudios transversales, cross-sectional o de prevalencia.** Estudian en todos los individuos de una población o, más frecuentemente, en una muestra representativa de esta la presencia de una determinada enfermedad, de un factor causal concreto o, a un tiempo, la presencia de enfermedad y sus posibles factores causales en un momento determinado del tiempo.
- c) **Estudios de casos y controles.** Comparan individuos seleccionados según tengan o no la enfermedad de interés. Asumiendo que un factor causal debería encontrarse con más frecuencia entre los individuos con enfermedad (casos) que entre los que no tienen (controles), si la prevalencia del antecedente de exposición, o su intensidad si es una variable cuantitativa, es mayor en los primeros, podrá hacerse evidente una asociación causal.
- d) **Estudios de cohortes.** Son estudios que se realizan sobre individuos cuyo grado de exposición es diferente, y en los que se observa, y cuantifica, la aparición a lo largo del tiempo de, al menos, un acontecimiento, o efecto, de interés. Dos únicos grupos, expuestos y no expuestos a un factor, o cohortes, para estudiar su efecto en el riesgo de enfermedad.

- e) **Estudios experimentales:** ensayos clínicos y comunitarios. Uno o varios factores estudiados son manipulados bajo condiciones controladas por los investigadores y donde se observan los cambios que se producen en el resultado, o respuesta, de interés científico; de estos los ensayos clínicos aleatorios (*randomized clinical trials*) son los estudios experimentales utilizados con mayor frecuencia, y se caracterizan fundamentalmente porque la asignación de los individuos al grupo tratamiento o al grupo de control es aleatoria, es decir, se basa en el azar con la misma probabilidad para todos los sujetos de ser asignado a uno u otro grupo. En el caso de los ensayos comunitarios, la intervención tiene una base comunitaria, la asignación es controlada, pero no aleatoria, el investigador decide qué comunidad recibe la intervención y cuál actúa de control, mientras los sujetos están sometidos o no a la intervención por el hecho de pertenecer a una u otra comunidad.

1.3. Evaluación del estado nutricional poblacional.

Uno de los aspectos claves de la epidemiología nutricional que la convierte en un campo de investigación extremadamente difícil consiste en la medición del estado nutricional como variable de exposición, analizando los distintos indicadores dietéticos, clínicos, antropométricos y bioquímicos. El estado nutricional de una persona o un colectivo es el resultado de la interrelación entre el aporte nutricional que recibe y las demandas nutritivas del mismo, necesarias para permitir la utilización de nutrientes, mantener las reservas y compensar las pérdidas. La determinación del estado nutricional es una necesidad fundamental en la situación actual de desarrollo sanitario, dada la estrecha relación entre nutrición y salud (Romaguera, 2007).

De manera conceptual es igual de válida la valoración nutricional para un individuo determinado como para un colectivo más o menos amplio, aunque no siempre se utilizará la misma metodología en ambas situaciones.

Desde el punto de vista de la medicina preventiva es fundamental la evaluación y supervisión en los distintos grupos fisiológicos y en el mayor porcentaje posible de población ubicada en un hábitat determinado. La información necesaria para la evaluación del estado nutricional no solo va a consistir en establecer la situación fisiopatológica, sino también las causas que pueden determinarlo. Múltiples son los datos que pueden ayudar a la evaluación del estado nutricional, pero fundamentalmente pueden ser agrupados en cinco apartados:

- Determinación de la ingesta de nutrientes.

- Determinación de la estructura y la composición corporal.
- Evaluación bioquímica del estado nutricional.
- Evaluación inmunológica y de pronóstico nutricional.
- Evaluación clínica del estado nutricional (Aranceta *et al.*, 2006).

1.4. Evaluación del consumo de alimentos en poblaciones.

El conocimiento de la ingesta de alimentos y por ende de energía y nutrientes en una población es de vital importancia para conocer su estado nutricional y poder planificar programas de intervención de forma coherente y de acuerdo a sus necesidades, así como para investigar las interrelaciones del estado nutricional con el estado de salud de la población.

La medición de la ingesta de alimentos en individuos y en poblaciones se realiza mediante diversos métodos o encuestas, que difieren en la forma de recoger la información y el periodo de tiempo que abarcan. La selección de un método dependerá fundamentalmente de la población, de los recursos disponibles, de los alimentos o nutrientes analizados y del diseño metodológico del estudio epidemiológico utilizado.

La información alimentaria de una población puede obtenerse a tres niveles distintos (Tabla 1):

Tabla 1. Niveles de obtención de la información alimentaria en la población.

<i>Nivel</i>	<i>Cadena alimentaria</i>	<i>Fuente</i>
Nacional	Disponibilidad alimentaria	Hojas de balance alimentario
Familiar	Compras de alimentos del hogar	Encuesta de presupuesto familiar
	Consumo de alimentos en el hogar	Encuesta de consumo familiar
Individual	Consumo de alimentos individual	Encuesta alimentaria individual

Fuente: (Serra-Majem *et al.* 2001).

- a) **Nivel nacional.**- Mediante hojas de balance alimentario, con lo que se obtiene la disponibilidad de alimentos de un país (Serra-Majem *et al.* 2006). La FAO publicó las primeras hojas de balance alimentario en 1949 que comprendían los períodos 1934-38 y 1947-48; en 1972 estableció el Sistema Computarizado y Entrelazado de Almacenamiento y Procesamiento de Datos sobre Productos Alimentarios y Agrícolas. La Organización de las Naciones Unidas para la

Alimentación y la Agricultura (FAO) y la OCDE (Organización para la Cooperación y Desarrollo Económico) publican periódicamente estimaciones de consumo bruto de alimentos en diversos países, estas hojas de balance muestran para cada producto las fuentes de suministro y su utilización. La cantidad total de alimentos producida más la cantidad total importada y reajustada para tomar en cuenta cualquier cambio que pudiera haber ocurrido en las existencias proporciona el suministro interno disponible durante el periodo de referencia:

$$\text{Producto} + \text{importaciones} - \text{exportaciones} + \text{cambio de la existencias (disminución o aumento)} = \text{suministro para la utilización interna}$$

(Cotier & Morón, FAO).

- b) **Nivel familiar.-** Mediante las encuestas de presupuestos familiares o los registros, inventarios y diarios dietéticos familiares (o de todo el hogar), que evalúan la disponibilidad o el consumo familiar de los alimentos, sobre una muestra representativa y estratificada de la población, se realiza una observación de los gastos durante una semana, con estos métodos se valora disponibilidad alimentaria familiar e individual, pero no se consideran las pérdidas por los procesos culinarios ni las sobras, tampoco se valoran las ingestas realizadas fuera de casa (Aranceta, 2001).
- c) **Nivel individual.-** Con lo que genéricamente se denomina encuestas alimentarias o nutricionales (Serra-Majem *et al.* 2006). Existen diferentes métodos para evaluar el consumo de alimentos a nivel individual, cada uno de ellos presenta ventajas e inconvenientes que es necesario valorar en función del tipo de información que se desea obtener (Tabla 2). Para estimar la ingesta usual o la ingesta actual a nivel individual, pueden seguirse dos tipos de orientaciones: registro de la ingesta actual y recuerdo de la ingesta realizada en el pasado (Aranceta, 2001) y estas pueden ser: diario dietético, recordatorio de 24 horas, cuestionario de frecuencia e historia dietética.

Tabla 2. Ventajas e inconvenientes de diversos métodos de estimación de la ingesta dietética individual.

<i>Ventajas</i>	<i>Inconvenientes</i>
<p><i>Diario dietético.</i></p> <ul style="list-style-type: none"> • Precisión en la estimación o cálculo de las porciones ingeridas. • El procedimiento no depende de la memoria del individuo 	<ul style="list-style-type: none"> • El individuo ha de saber leer, escribir y contar. • Requiere mucho tiempo y cooperación por parte del encuestado, especialmente el registro por pesada. • Los patrones de ingesta habitual pueden ser influenciados durante el periodo de registro. • El coste de codificación y análisis es elevado.
<p><i>Recordatorio de 24 horas.</i></p> <ul style="list-style-type: none"> • El tiempo de administración es corto. • El procedimiento no altera la ingesta habitual del individuo. • Es útil para cualquier tipo de patrón alimentario. • Un solo contacto es suficiente. • Recordatorios seriados pueden estimar la ingesta habitual en un individuo. • Puede usarse en personas analfabetas. • Su coste es moderado. • Altas tasas de respuesta. 	<ul style="list-style-type: none"> • Un solo recordatorio de 24 horas no estima la ingesta habitual de un individuo. • Es difícil de estimar con precisión el tamaño de las porciones. • Depende de la memoria del encuestado. • Son necesarios entrevistadores entrenados para su administración. • Aplicación limitada en ancianos y niños.
<p><i>Cuestionario de frecuencia de consumo.</i></p> <ul style="list-style-type: none"> • Puede estimar la ingesta habitual de un individuo. • Rápido y sencillo de administrar. • El patrón de consumo habitual no se altera. • No requiere entrevistadores entrenados. • Coste de administración muy bajo, especialmente si se realiza por correo. • Capacidad de clasificar individuos por categorías de consumo, útil en estudios epidemiológicos. 	<ul style="list-style-type: none"> • El desarrollo del instrumento (cuestionario) requiere un esfuerzo considerable y mucho tiempo. • Dudosa validez de la estimación de la ingesta de individuos o grupos con patrones dietéticos muy diferentes de los alimentos de la lista. • Ha de establecerse la validez para cada nuevo cuestionario y población. • Requiere memoria de los hábitos alimentarios en el pasado. • Poca precisión en la estimación y cuantificación de las porciones de alimentos. • El recordatorio de la dieta en el pasado puede estar sesgado por la dieta actual. • El tiempo y las molestias para el encuestado aumentan de acuerdo al número y complejidad de la lista de alimentos y los procedimientos de cuantificación. • No es útil en ancianos y niños. • Poco válido para la mayoría de vitaminas y minerales.
<p><i>Historia dietética.</i></p> <ul style="list-style-type: none"> • Puede dar una descripción más completa y detallada de la ingesta alimentaria habitual y pasada que los otros métodos. • Puede usarse en personas analfabetas. 	<ul style="list-style-type: none"> • Requiere un entrevistador muy entrenado, generalmente un dietista. • Requiere tiempo y mucha cooperación por parte del entrevistado • El coste de administración es elevado. • No existe una manera estándar de realizar la historia dietética.

Fuente: (Serra-Majem *et al.* 2006).

1.5 Evaluación de la composición corporal (antropometría).

El estudio de la composición corporal es un pilar básico en la evaluación nutricional y se precisan técnicas que permitan medir adecuadamente los comportamientos corporales (Goodpaster, 2002). El análisis de la composición corporal es también imprescindible para valorar el impacto que producen, por ejemplo, las intervenciones reductoras de peso en los comportamientos corporales, dirigidas a conseguir la cantidad de masa grasa saludable.

Se han producido avances considerables en los métodos de análisis de la composición corporal; sin embargo, algunas técnicas no están disponibles para su empleo en la práctica clínica debido a su coste, infraestructura necesaria, complejidad y efectos sobre los pacientes en exploraciones repetidos (Jebb & Elia, 1993; Lee & Gallagher, 2008; Macdonald *et al.* 2011). Entre los métodos actuales, los más asequibles en clínica y estudios epidemiológicos son la antropometría, el análisis por impedancia bioeléctrica (BIA) y la absorciometría (Fogelholm *et al.* 1997). La evaluación de la masa libre de grasa y la grasa corporal a través de estas técnicas proporcionan información valiosa sobre los cambios en la composición corporal, con aumento o pérdida de peso, y la actividad física durante el envejecimiento, el uso de percentiles en estas técnicas permiten la clasificación de los pacientes subalimentados o sobrealimentados con variaciones importantes en el estado nutricional que no serían detectados solo con antropometría (Wright *et al.* 2008; Kyle *et al.* 2003).

La antropometría, ha sido utilizada desde hace décadas tanto en estudios individuales como de grupo, presentan un alto coeficiente de variación intraanálisis e interanálisis. Sin embargo, toda valoración de la composición corporal debe ser complementada por la antropometría. En concreto, la determinación del peso, la talla y el perímetro de cintura son imprescindibles en cualquier exploración clínica (Wagner & Heyward 1999; Bellido *et al.* 2010).

El peso corporal.- Es una variable antropométrica y el método más sencillo para valorar el estado nutricional a nivel individual y poblacional, y la medición debe realizarse bajo ciertas condiciones para que sea fiable: usar báscula electrónica o de balancín, el sujeto deberá estar en ropa interior o bata, sin zapatos, y, si es posible realizar la medición después de haber evacuado la vejiga y el recto.

La talla.- Debe medirse con el individuo en bipedestación, con la espalda en contacto con un estadiómetro y sin calzado. La cabeza se ajusta de modo que una línea horizontal pase por el conducto auditivo, y la parte inferior de la órbita del ojo, y los pies deben estar paralelos con los tobillos juntos; el brazo móvil del estadiómetro se baja hasta tocar la parte superior de la cabeza y se mide la altura hasta valores de 1 mm (Bellido *et al.* 2010; Lapunzina & Aiello, 2001).

Índice de Masa Corporal (IMC).- Los valores de peso y talla se emplean habitualmente formando parte de los denominados índices ponderales; el de más amplio uso y aceptación es el índice de masa corporal (IMC), que se obtiene

dividiendo el peso corporal del individuo expresado en kilogramos por su estatura expresada en metros y elevada el cuadrado: $IMC = P \text{ (Kg)} / Talla \text{ (m}^2\text{)}$; aunque el IMC es más bien un indicador de la corpulencia, presenta una buena correlación con la grasa corporal total en el caso de los individuos obesos y se usa para clasificar los grados de obesidad según los puntos de corte que la Organización Mundial de Salud (OMS) establece (Tabla 3).

Tabla 3. Puntos de corte para la clasificación de la obesidad según IMC.

Clasificación	IMC (Kg/m ²)
Peso insuficiente	< 18.50
Normo peso	18.50 – 24.99
Sobrepeso	25.00 – 29.99
Obesidad	≥ 30.00

Fuente: Organización Mundial de la Salud.

2. EVALUACION DE LOS PATRONES DE ALIMENTACIÓN

El análisis de la relación entre hábitos alimentarios y salud ha iniciado por estudiar el rol que pueden jugar ciertos nutrientes en la etiopatogénesis de ciertas enfermedades. La complejidad de la relación entre la ingesta de alimentos y la enfermedad no se puede atribuir a un solo nutriente, sino a múltiples y/o a una gran variedad de alimentos (Román-Viñas *et al.* 2009). Las principales causas de mortalidad en países desarrollados, como enfermedades crónicas, enfermedades cardiovasculares (ECV), diabetes mellitus y algunos tipos de cáncer (mama, colon y otros), están estrechamente relacionadas con la dieta, además de otros factores como el tabaquismo, el consumo de alcohol y la falta de actividad física, sin dejar de un lado a la susceptibilidad individual a ciertos procesos. La vigilancia nutricional es uno de los principales objetivos de la nutrición comunitaria que tiene la finalidad de monitorear el estado nutricional de una población o grupos seleccionados. Este proceso hace posible identificar grupos en riesgo nutricional, a fin de establecer prioridades para su intervención, predecir las tendencias y evaluar las intervenciones nutricionales. Los estudios de consumo de alimentos son esenciales para el desarrollo de políticas alimentarias dentro de una región o un país (Aranceta, 2001)

Diferentes métodos y estrategias se han establecido para evaluar el consumo de alimentos y nutrientes en una población, en un grupo de individuos o a nivel individual, y la elección de estos dependerá de cada caso, de los objetivos del

estudio, del nivel de información requerida, de las características de la muestra y de las personas que tomarán parte del estudio, así como también, del presupuesto y los recursos disponibles para la encuesta (Aranceta *et al.* 1998). Existe controversia sobre cual de estos métodos es el más adecuado. Muchos estudios al respecto concluyen que, la mayoría de las actuales encuestas dietéticas, permite la estimación de lo que los individuos o un grupo poblacional consumen, pero ninguna de ellas puede estimar de manera inequívoca el verdadero nivel de inadecuación nutricional ya que se han identificado muchos factores que afectan la exactitud de los datos obtenidos, como por ejemplo el instrumento de la encuesta seleccionada, si la medida de la ingesta es habitual o real, el número de días evaluados, el tamaño de las porciones, nivel educativo del encuestado, etc. (Cade *et al.* 2001). No obstante a nivel poblacional los métodos más utilizados en todo el mundo han sido el recordatorio de 24 horas y el cuestionario de frecuencia de consumo, pero sigue siendo el recordatorio de 24 horas el que recoge con mayor objetividad y validez la ingesta actual de una población (ENIB 1999-2000; Wakimoto & Block, 2001; Holmes *et al.* 2007).

Los estudios transversales para monitorear las tendencias en los patrones de alimentación en población han sido repetidos en varios países como Estados Unidos de Norte América, Finlandia, Reino Unido, Dinamarca, etc.

En España, a partir de 1960 el Instituto Nacional de Estadística (INE), ha llevado a cabo varias encuestas presupuestarias en hogares, estas encuestas consideran la evaluación de los alimentos disponibles para los miembros del hogar durante un periodo de tiempo determinado. El Ministerio de Agricultura, Pesca y Alimentación (MAPA) también ha llevado un sistema de seguimiento de un panel de consumidores. Ambos conjuntos de datos se refieren a la disponibilidad de alimentos, pero no proporcionan datos de consumo de alimentos. Otras encuestas nutricionales se han desarrollado en algunas regiones de España considerando el estado nutricional de la población, medidas antropométricas y marcadores bioquímicos, siendo la primera la desarrollada en el País Vasco EINUT-I (Aranceta *et al.* 1998), años más tarde encuestas con procedimientos similares a EINUT-I fueron desarrolladas a nivel regional en otras comunidades autónomas como Madrid (1992), Cataluña (ENCAT 1992 – 2003), Islas Canarias (1983-1985 & 1997-1998), Murcia (1990), Valencia (1993-1994), Andalucía (1996-1997) y las realizadas en Baleares (ENIB 1999-2000 & OBEX 2009-2010), pero hasta el momento no se ha realizado una encuesta nutricional con metodología similar a las desarrolladas para una muestra representativa a nivel nacional (Tur *et al.* 2004; Ribas *et al.* 2007; Serra-Majem *et al.* 2007).

2.1 Evaluación de la ingesta dietética recomendada.

Los primeros datos españoles en disponibilidad de alimentos a nivel nacional, están basados en las hojas de balance de alimentos de la Organización de las Naciones Unidas para la Agricultura y Alimentación (FAO), que hicieron posible una visión general de las tendencias de la alimentación en la población española a partir de los años cuarenta (Aranceta, 2001). Como ya se ha descrito con anterioridad, los hábitos alimentarios de una población son factores determinantes en su estado de salud y por otra parte son también de importantes repercusiones económicas y políticas (Serra-Majem *et al.* 2007).

Los estudios epidemiológicos realizados a partir de la década de los años sesenta del siglo pasado han permitido dejar en claro la relación entre los hábitos alimentarios y la prevalencia de muchas enfermedades crónicas en sociedades desarrolladas, lo que ha provocado un cambio en la orientación de prioridades en materia de salud y en los programas de salud pública, prestando principal atención al enfoque del programa, financiación, prestación del servicio, el papel de los actores principales, así como el proceso, contenido y aplicación de políticas de salud, poniendo en primer plano los retos y las áreas que requieren de un análisis más profundo (García-Armesto *et al.* 2010; Lock *et al.* 2010; Schäfer *et al.* 2010;). La evolución epidemiológica nutricional ha demostrado la importancia no solo de la ingesta cuantitativa de alimentos, sino también de la estructura, la variedad y otros determinantes cualitativos de un consumo normal de alimentos. El objetivo de las políticas de alimentación y nutrición es facilitar a través de estrategias específicas una oferta de alimentos nutritivos, para que las necesidades nutricionales de una población se cumplan, para este fin las autoridades sanitarias así como las sociedades científicas cuentan con dos herramientas de gran valor estratégico en términos de salud pública: objetivos nutricionales y guías alimentarias.

- a) **Objetivos nutricionales.-** En 1994 la Sociedad Española de Nutrición Comunitaria (SENC), con el consenso de la Unidad de Nutrición de la Oficina Regional Europea de la Organización Mundial de la Salud (OMS), definió los objetivos nutricionales para la población Española, con la finalidad de facilitar el análisis de una ingesta baja o elevada de alimentos y nutrientes en la población, estos objetivos mostraban similitud a las recomendaciones realizadas por la Organización Mundial de la Salud (OMS). Muchos países del mediterráneo han elaborado objetivos nutricionales y guías alimentarias así

como un sistema de monitoreo para la obtención actualizada de información nutricional, pero si bien es cierto muchos de ellos no han desarrollado por completo políticas estructuradas sobre nutrición, esto puede ser explicado debido a que la nutrición recibe poca atención de la salud pública tal vez por que es considerada como menos relevante como factor de riesgo para enfermedades crónicas en el mediterráneo y por el rol de la Unión Europea en las políticas de agricultura, lo que repercute al desarrollo de políticas en nutrición (Serra-Majem *et al.* 1999). En España el desarrollo de políticas no fue hasta el año 2000, que la SENC definió los objetivos intermedios y finales de nutrición (Tabla 4), para los cuales fueron considerados los hábitos de alimentación de la población española, bajo el contexto de una dieta Mediterránea, los análisis de diferentes intervenciones dietéticas en España, hacen hincapié a la atención de aquellas intervenciones prioritarias, básicamente a la reducción en el consumo de grasa total, grasa saturada y aquellos alimentos considerados como fuente de calorías vacías (Serra-Majem *et al.* 1999; Serra-Majem & Aranceta, 2001).

Tabla 4. Objetivos nutricionales para la población española: Consenso de la Sociedad Española de Nutrición Comunitaria, 2000 (Serra Majem & Aranceta, 2001).

	Objetivos intermedios	Objetivos finales
Lactancia materna	4 meses (exclusiva)	≥ 6 meses
Fibra dietética	> 22 g/d	> 25 g/d
Folato	> 300 µg/d	> 400 µg/d
Calcio	≥ 800 mg/d	≥ 800 mg/d
Sodio (sal de mesa)	< 7 g/d	< 6 g/d
Yodo	150 µg/d	150 µg/d
Fluoruros	1 mg/d	1 mg/d
Actividad física (PAL)	↑↑ No información	PAL > 1.75
Índice de Masa Corporal (Kg/m ²)	< 25	21 - 23
Grasa total	≤ 35 % de energía total	30 – 35 % de energía total
AGS	< 10% de energía total	7 – 8 % de energía total
AGM	20 % de energía total	15 – 20 % de energía total
AGP	5 % de energía total	5 % de energía total
AGP tipo n-6		2 g linoleico
AGP tipo n-3		+ 200 mg DHA
Colesterol	< 350 mg/d	< 300 mg/d
Carbohidratos totales	> 50 % de energía total	50 – 55 % de energía total
Dulces		< 4 por día
Fruta	> 300 g/d	> 400 g/d
Verdura	> 250 g/d	> 300 g/d
Alcohol	< 2 vasos/d	< 2 vasos/d

PAL = Physical activity level o Nivel de actividad física; AGS = Ácidos grasos saturados; AGM = Ácidos grasos monoinsaturados.; AGP = Ácidos grasos poliinsaturados; DHA = Ácido docosahexaenoico.

b) **Guías alimentarias:** El proceso de elaboración de la actual edición de las guías alimentarias para la población española se inició en 1999, donde un grupo de expertos en materia de salud y comunidad científica fueron involucrados, cada grupo de trabajo analizó un grupo de alimentos en paralelo bajo una estructura similar como composición y valor nutritivo de los alimentos, aspectos culturales y antropológicos, importancia socioeconómica, tendencias de consumo, la preparación habitual de los alimentos y su impacto en la pérdida de nutrientes, el desarrollo de factores de riesgo, efectos de protección, efectos negativos o riesgos de seguridad; bajo estas directrices, en el año 2000 la Sociedad Española de Nutrición Comunitaria publicó las guías alimentarias para la población española (Tabla 5); además de los diez pasos importantes que conducen a una dieta saludable, para reducir los índices de sobre peso y obesidad no solo en la población adulta, sino también en los grupos más jóvenes incluidos también los niños donde la prevalencia de la obesidad es mayor en relación a otros países Mediterráneos, como, Italia, Malta y Grecia (Aranceta, *et al.* 2001; Serra-Majem & Aranceta Bartrina, 2001; Neira & de Onis, 2006), es importante recalcar también que existen otras etapas de la vida de grupos específicos a los que es necesario dirigir especial atención en la manera de alimentarse, como lo es durante el embarazo y la lactancia, la buena nutrición en estas etapas, son determinantes para la salud del niño y de la madre, en España el seguimiento en estas etapas es considerado poco frecuente (Ortega, 2001). Las guías alimentarias en sus diferentes modalidades de presentación (pirámide, plato, abanico, etc.), tienen como finalidad educar de manera más práctica a todos los grupos poblacionales, y dar cumplimiento lo mejor posible a los objetivos nutricionales, bajo esta línea un gran número de estudios han sido publicados en diferentes países del mundo con el objetivo de implementar estrategias de educación que ayuden a evitar enfermedades carenciales, reducir los índices de sobre peso y obesidad así como enfermedades crónicas relacionadas con la alimentación (Turrini *et al.* 1999; Fregapane & Asencio-García, 2000; Soriano *et al.* 2000; Kant & Graubard, 2006).

Tabla 5. Pirámide de la alimentación saludable.

<i>Frecuencia por categoría</i>	<i>Alimentos incluidos en cada nivel</i>	<i>Frecuencia de consumo recomendado</i>	<i>Tamaño de la porción</i>	<i>Medida casera</i>	
CONSUMO DIARIO	Primer nivel (base de la pirámide): Patatas, arroz, pan, pan de grano entero, pasta, variedad de harinas y cereales.	4 - 6 raciones/día	60-80 g pasta, arroz 40-60 g pan 150-200 g patatas	1 medio plato 3-4 rebanadas 1 papa grande o 2 pequeñas	
	Agua	4-8 raciones/día	200 ml aprox.	1 vaso o 1 botella pequeña	
	Segundo nivel: Los vegetales están localizados de lado izquierdo (lechuga, tomate, zanahoria, coliflor, puerros, cebollas, etc.)	≥ 2 raciones/día	150-200 g	1 plato de ensalada 1 plato de verdura cocida 1 tomate grande 2 zanahorias las guarniciones pueden ser 1/2 ración	
	Las frutas están localizadas de lado derecho (naranjas, manzanas, peras, uvas, fresas, etc.)	≥ 3 raciones/día	120-200 g	1 media pieza/1 tza cereza, fresas, etc./2 rebanadas de melón	
	Tercer nivel (nivel superior): Leche, productos lácteos como yogurt, queso, queso fresco, queso cottage, etc. Aceite de oliva	2-4 raciones/día	200-250 ml de leche 200-250 g yoghurt 40-60 g de queso maduro 125 g de queso fresco	1 tza de leche 2 unid. de yogurt 2-3 rebanadas de queso 1 porción individual 1 cucharada	
	Actividad física	3-5 raciones/día Diaria	10 ml ≥ 30 minutos		
	CONSUMO SEMANAL	Cuarto nivel (nivel superior): Pescado	Alternadamente entre ellos	125-150 g (peso neto)	1 filete individual 2-3 rebanadas de pescado
		Carne magra, aves y huevo		100-125 g (peso neto)	1 filete pequeño, 1 pierna pollo, 1/4 conejo, 1-2 huevos 1 plato individual
		Legumbres (frijol, garbanzo, lentejas, soja, etc.)	2-3 rac./sem.	60-80 g	(150-200 g de peso cocinados)
		Frutos secos		20-30 g	1 puñado o paquete individual.
CONSUMO OCACIONAL	Quinto nivel: Productos de carnicería (chorizo, morcilla, etc.) y carne grasa.	Ocasionalmente		Moderadamente	
	Sexto nivel: Dulces, pastelillos, snacks dulces o salados, bebidas dulces.	< 4 ocasiones/día		Moderadamente	
	Séptimo Nivel: mantequilla, margarina, pasteles fabricados, bollos.	Ocasionalmente		Moderadamente	

2.2 Índice de Calidad de la Dieta o Diet Quality Index (DQI).

La medición de la calidad de la dieta en general, ha sido un método sugerido para evaluar la relación entre dieta-enfermedad, centrándose en los elementos

nutricionales más importantes considerados en la promoción de la salud y la prevención de enfermedades, como es la variedad y la diversidad de la dieta. El DQI original está basado en las recomendaciones de 8 grupos de alimentos y nutrientes, realizadas por el comité de Dieta y Salud del consejo nacional norteamericano de investigación de alimentación y nutrición, según el reporte de dieta y salud en 1989 (WDC: Academia Nacional de Ciencias, 1989; Haines *et al.* 1999); estas 8 variables incluyen, grasa total, grasa saturada, colesterol, frutas y vegetales, granos y legumbres, proteína, sodio y calcio, que se cuantifican y suman de modo que proporcionan una puntuación como medida global del índice de calidad de la dieta. Las puntuaciones van desde 0 a 16, donde 0 refleja el mayor índice de calidad y 16 el más bajo. El índice fue actualizado posteriormente, para evaluar otros aspectos de la dieta que no eran abordados en el índice original, incluyendo variedad, moderación y proporcionalidad, como se refleja en la Pirámide de la alimentación y las guías alimentarias para los Norteamericanos (5ª Edición., USDA 1992) así como los cambios en las recomendaciones y políticas nutricionales (Haines *et al.* 1999; Newby *et al.* 2003). En los últimos años, los métodos para medir la calidad de la dieta han evolucionado y han sido planteados una serie de sistemas de puntuación. Numerosos estudios se han publicado donde se evalúa la eficacia de los índices de calidad de la dieta para predecir el estado nutricional y de salud de una población, enfocados principalmente a la descripción de las herramientas actuales de calidad y sus aplicaciones, así como la asociación de las puntuaciones más altas con los niveles de morbilidad y mortalidad, y la solidez de esta asociación en función de sus resultados (Wirt & Collins, 2009). Se ha demostrado que el El DQI es un índice eficaz para la comparación de la calidad de la dieta, permitiendo una comprensión global de la calidad de la dieta entre países o grupos poblacionales, además de ser útil para orientar el desarrollo de políticas y/o programas que mejoren la salud pública (Kim *et al.* 2003).

Los índices de calidad más importantes son: Índice de Alimentación Saludable (*Healthy Eating Index = HEI*), Indicador de la dieta saludable (*the Healthy Food Index = HDI*), el Índice de calidad de la dieta (*Diet Quality Index = DQI*), la Dieta de calidad (*Diet Quality Score = DQS*) y la adherencia a la dieta Mediterránea (*Mediterránea Diet Score = MDS*).

Dependiendo de la inclusión o exclusión de determinados alimentos o nutrientes, los índices de calidad de la dieta se pueden generar para reflejar una ingesta dietética saludable, poco saludable o una combinación de ambas. Los instrumentos de evaluación de la dieta pueden ser adaptados para su uso en la práctica clínica y para la evaluación de la ingesta alimentaria, particularmente para

identificar cuales alimentos necesitan incrementarse para obtener una puntuación más saludable y por lo tanto potencializar la reducción del riesgo de enfermedades crónicas y la reducción de los índices de mortalidad por estas causas (Trichopoulou *et al.* 1995; McCullough *et al.* 2000; Fitzgerald *et al.* 2002; Seymour *et al.* 2003; Wirt & Collins, 2009) Tanto el Índice de Calidad de la Dieta - Internacional (DQI-I) adaptado para la evaluación de adherencia a la dieta Mediterránea, como el índice de alimentación saludable (HEI), son considerados como instrumentos ideales para una evaluación más completa en la población de Baleares, por un lado la variedad de la dieta basado en los grupos de alimentos y por otro la ingesta de nutrientes y su asociación con enfermedades crónicas (Tablas 6 y 7) (Tur *et al.* 2005; Mariscal-Arcas *et al.* 2007; Bond, 2009).

Tabla 6. Índice de Calidad de la Dieta - Internacional (DQI-I).

<i>Componente</i>	<i>Puntuación Máxima</i>	<i>Puntuación</i>	<i>Punto de corte</i>
Variedad	0 - 20		
Variedad general por grupos de alimentos	0 - 15	15	≥ 1 ración de cada grupo/d
		12	1 grupo de alimentos ausente/d
		9	2 grupos de alimentos ausentes/d
		6	3 grupos de alimentos ausentes/d
		3	≥ 4 grupos de alimentos ausentes/d
		0	Ninguno de los grupos de alimento
Variedad dentro del grupo de alimentos proteicos	0 - 5	5	≥ 3 diferentes fuentes/d
		3	2 diferentes fuentes/d
		1	1 fuente/d
		0	Ninguna
Adecuación	0 - 40		
Grupo de vegetales	0 - 5	5	> 100% de la recomendación
		3	50 - 100% de la recomendación
		1	< 50% de la recomendación
		0	0% de la recomendación
Grupo de frutas	0 - 5	5	> 100% de la recomendación
		3	50 - 100% de la recomendación
		1	< 50% de la recomendación
		0	0% de la recomendación
Grupo de granos	0 - 5	5	> 100% de la recomendación
		3	50 - 100% de la recomendación
		1	< 50% de la recomendación
		0	0% de la recomendación
Fibra	0 - 5	5	> 100% de la recomendación
		3	50 - 100% de la recomendación
		1	< 50% de la recomendación
		0	0% de la recomendación
Proteína	0 - 5	5	> 100% de la recomendación
		3	50 - 100% de la recomendación
		1	< 50% de la recomendación
		0	0% de la recomendación
Hierro	0 - 5	5	> 100% de la recomendación
		3	50 - 100% de la recomendación
		1	< 50% de la recomendación
		0	0% de la recomendación
Calcio	0 - 5	5	> 100% de la recomendación
		3	50 - 100% de la recomendación
		1	< 50% de la recomendación
		0	0% de la recomendación
Vitamina C	0 - 5	5	> 100% de la recomendación
		3	50 - 100% de la recomendación
		1	< 50% de la recomendación
		0	0% de la recomendación

Tabla 6. Continuación

<i>Componente</i>	<i>Puntuación Máxima</i>	<i>Puntuación</i>	<i>Punto de corte</i>
Moderación	0 – 30		
Grasa total	0 – 6	6 3 0	≤ 30% del total de energía/d > 30 – 35% del total de energía/d > 35% del total de energía/d
Grasa saturada	0 – 6	6 3 0	≤ 7% del total de energía/d > 7 – 10% del total de energía/d > 10% del total de energía/d
Colesterol	0 – 6	6 3 0	≤ 300 mg/d > 300 – 400 mg/d > 400 mg/d
Sodio	0 – 6	6 3 0	≤ 2400 mg/d > 2400- 3400 mg/d > 3400 mg/d
Calorías vacías	0 – 6	6 3 0	≤ 3% del total de la energía/d > 3 – 10% del total de la energía/d > 10% del total de la energía/d
Balance general	0 - 10		
Balance macronutrientes (carbohidratos - proteínas - grasa)	0 – 6	6 4 2 0	55- 65:10 – 15:15-25 52-68:9 – 16:13-27 50-70:8 – 17:12-30 Otras combinaciones
Balance ácidos grasos	0 – 4	4 2 0	P/S = 1 – 1.5; M/S = 1 – 1.5 P/S = 0.8 – 1.7; M/S = 0.8 – 1.7 Otras combinaciones

Fuente: (Tur *et al.* 2005; Mariscal-Arcas *et al.* 2007).

2.3 Índice de Alimentación Saludable (HEI-2005).

El Índice de Alimentación Saludable (HEI-2005), HEI fue creado por el Departamento de Agricultura de los Estados Unidos (USDA) en 1995, para monitorear la calidad de la dieta de los americanos conforme a las guías dietéticas federales. El HEI es usado por la USDA con el objetivo principal de monitorear los cambios en la nutrición y salud de la Nación, promover hábitos alimentarios y estilos de vida saludables, y un resultado clave es el cambio en los hábitos alimentarios más consistentes con las guías alimentarias para los norteamericanos (Guenther *et al.* 2007). El lanzamiento de las nuevas Guías Alimentarias para los Norteamericanos en 2005 motivó la revisión del HEI. Los estándares de los grupos de alimentos están basados en las recomendaciones que se encuentran en My Pyramid y fueron creados usando un enfoque de la densidad; es decir, que son expresados como un porcentaje de calorías o por 1000 calorías. Los antecedentes, justificación e importancia de centrarse en el HEI como una medida de la calidad de la dieta ha sido bien documentada en numerosos estudios llevados a cabo para medir la relación de la dieta con la obesidad y enfermedades asociadas (Guo *et al.* 2004; Jen *et al.* 2007; Freedman *et al.* 2008; Savoca *et al.* 2009), así como la asociación con una alta concentración de biomarcadores plasmáticos como α -

carotenos, β -carotenos, β -criptoxantina, luteína y vitamina C (Hann CS., et al. 2001).

Los componentes de HEI-2005 y los estándares de puntuación se muestran en la Tabla 7:

Tabla 7. Índice de Alimentación Saludable – 2005 (HEI-2005). Componentes y estándares para puntuación¹ (Guenther *et al.* 2007).

Componentes	Máxima puntuación	Estándar para máxima puntuación	Estándar para la mínima puntuación cero.
Fruta total (incluidos 100% zumo)	5	≥ 0.8 tza o equiv. /1000 Kcal.	No fruta
Fruta entera (no zumo)	5	≥ 0.4 tza o equiv. /1000 Kcal.	No fruta entera
Total de vegetales	5	≥ 1.1 tza o equiv. /1000 Kcal.	No vegetales
Vegetales verdes y naranja y legumbres ²	5	≥ 0.4 tza o equiv. /1000 Kcal.	No vegetales
Total de granos (cereales)	5	≥ 3.0 oz o equiv. /1000 Kcal.	No granos (cereales)
Granos enteros	5	≥ 1.5 oz o equiv. /1000 Kcal.	No granos enteros
Leche ³	10	≥ 1.3 tzas o equiv. /1000 Kcal.	No leche
Carne y frijol	10	≥ 2.5 oz o equiv. /1000 Kcal.	No carne o frijol
Aceites ⁴	10	≥ 12 g / 1000 Kcal.	No aceites
AGS(Ácidos grasos saturados)	10	≤ 7% de energía ⁵	≥ 15% de energía
Sodio	10	≤ 0.7 g / 1000 Kcal.	≥ 2.0 g /1000 Kcal.
SoFAAS	20	≤ 20% de energía	≥ 50% de energía

¹ Las ingestas entre los niveles mínimo y máximo son proporcionales, excepto grasa saturada y sodio.

² Las legumbres cuentan como vegetales sólo después de carne y frijoles, es estándar es carne.

³ Incluye productos de la leche, tales como leche líquida, yogurt, queso y bebida de soja.

⁴ Incluye aceites vegetales hidrogenados, aceites de pescado, frutos secos y semillas.

⁵ Grasa saturada y sodio obtienen una puntuación de 8 para los niveles de ingesta que reflejan las Guías alimentarias 2005, <10% de calorías de grasas saturadas y 1.1 g de sodio/1,000 Kcal., respectivamente.

SoFAAS = Calorías de grasas sólidas, bebidas alcohólicas y azúcares añadidos.

II. OBJETIVOS



1. OBJETIVO GENERAL

Como se ha descrito con anterioridad, los análisis tradicionales de la epidemiología nutricional examinan la relación entre enfermedad y uno o varios nutrientes o alimentos. El análisis de los patrones alimentarios de la población ha surgido como una alternativa y enfoque complementario para examinar la relación entre la dieta y el riesgo de padecer enfermedades crónicas, y para analizar el consumo de alimentos o nutrientes que puedan ser más predictivos del riesgo de enfermedad.

A partir de la década de los años sesenta del pasado siglo, España ha experimentado dramáticos cambios sociales, incluyendo la masiva migración de la población rural a las grandes ciudades, la masiva inmigración llegada desde el exterior, especialmente desde los países latinoamericanos y del Magreb, la incorporación de las mujeres a la vida laboral añadida a los procesos de una rápida urbanización a partir de 1980; estos hechos han marcado importantes cambios en los hábitos alimentarios de la población, ya que la alimentación familiar se ha tenido que organizar de manera diferente a la tradicional. A partir de entonces se inicia una oferta alimentaria diferente, caracterizada por una mayor oferta y variedad de alimentos, predominando los alimentos procesados, abandonando cada vez más los alimentos frescos y las prácticas de producción artesanal para el autoconsumo.

La alimentación equilibrada es parte de un estilo de vida saludable, así como otros elementos de la vida diaria como la actividad física, el consumo o no del tabaco o de alcohol y el estrés. En los últimos años, los hábitos alimentarios de la mayoría de los países del mundo han evolucionado desde un patrón dietético tradicional, hacia patrones de ingesta caracterizados por un mayor consumo de grasa saturada, baja ingesta de frutos y vegetales, y un estilo de vida más sedentario. Los países bañados por el Mediterráneo no están exentos de estos cambios, pero cabe destacar que aun se conservan algunos elementos característicos del patrón dietético tradicional, como es la ingesta de aceite de oliva, cereales integrales, pan y derivados, legumbres, frutos secos, frutas, verduras y algunos derivados de la leche (queso y yogur), el vino durante las comidas, además de la inclusión de muchos condimentos y especias según la técnica culinaria utilizada para conservar las cualidades de los alimentos. Las Islas Baleares han experimentado y experimentan importantes movimientos migratorios, tanto nacionales como extranjeros, y por ser una región con una fuerte actividad turística experimenta también movimientos estacionales y definitivos que han supuesto la introducción de nuevos hábitos alimentarios, nuevas técnicas culinarias y una mayor variedad

de nuevos alimentos. Ante esta problemática, es necesario la elaboración de estudios epidemiológicos nutricionales, con resultados fiables, que permitan detectar los cambios en la manera de alimentarse de la población e identificar las posibles causas de morbi-mortalidad, permitiendo así reorientar las estrategias y políticas para la prevención, control y tratamiento de las enfermedades asociadas a la alimentación.

El **objetivo general** de esta tesis es evaluar los hábitos alimentarios e ingesta nutricional en la población adulta de las Islas Baleares. Los objetivos nutricionales y las guías alimentarias para la población Española, así como también los índices de calidad de la dieta, en tanto que puntos de referencia importantes para monitorear los cambios en los patrones de alimentación, sin pasar por alto el contexto de un modelo tradicional de la dieta mediterránea.

El objetivo general se divide a su vez en los siguientes **objetivos específicos**:

- 1.1. Analizar la calidad de la dieta de la población balear, en base al cumplimiento de las guías alimentarias diseñadas para la población española.
- 1.2. Determinar la frecuencia de consumo por grupos de alimentos, por grupos de edad y sexo de los adultos de Baleares.
- 1.3. Determinar las diferencias entre los patrones actuales de nutrición, en base al cumplimiento de los factores incluidos en las guías alimentarias OMS/FAO y los objetivos comunes de salud pública y nutrición, los cuales incluyen: Ácidos grasos (AS), ácidos grasos saturados (AGS), frutas y vegetales (F y V) y fibra dietética.
- 1.4. Analizar los cambios en la ingesta de nutrientes en base al cumplimiento de los objetivos finales de nutrición - 2010 para la población española.
- 1.5. Analizar la calidad de la dieta, utilizando el Índice de Calidad de la Dieta – Internacional (DQI-I) y el Índice de Alimentación Saludable (HEI), como instrumentos ideales para evaluar los patrones de alimentación bajo el contexto de la dieta mediterránea.

- 1.6. Analizar las tendencias en la ingesta de energía y nutrientes en la población adulta de las Islas Baleares, en base a las recomendaciones de las ingestas diarias recomendadas de energía y nutrientes para la población española.

III. MATERIAL Y MÉTODOS



1. Diseño del estudio:

Es un estudio epidemiológico transversal, basado en una encuesta nutricional realizada en las Islas Baleares entre los años 2009 y 2010.

2. Diseño de la muestra:

El tamaño muestral teórico fue de 1500 individuos, con una muestra final de 1388 individuos que representa un 93% de participación; este número de individuos permite estimar acontecimientos considerando un error tipo I = 0.05, un error tipo II = 0.01 y una precisión del 5%.

El universo de la muestra fue considerando todos los habitantes de las Islas Baleares de edades comprendidas entre 16 a 65 años, siendo la población de origen todos los habitantes de estas edades, residentes y censados en los municipios de las Islas Baleares (IBESTAT, 2011). La técnica de muestreo fue estratificada en dos etapas, de acuerdo al hábitat y aleatoria por conglomerados, siendo la unidad primaria de muestreo los municipios de las Islas Baleares y la última los individuos censados en estos municipios. La muestra se obtuvo a partir del último Censo de Población (INE 2008), para cada uno de los sesenta y siete municipios de las Islas Baleares. Las mujeres embarazadas no fueron consideradas en el estudio.

3. Encuestas alimentarias:

La obtención de información sobre los hábitos alimentarios y la ingesta nutricional se realizó mediante la aplicación de un recordatorio de 24 horas y un cuestionario semicuantitativo de frecuencia de consumo de alimentos (FFQ), previamente validado (Martín-Moreno *et al.* 1993) y aplicado en otros estudios en la población española (Aranceta *et al.* 1993; Tur *et al.* 2004; Ribas *et al.* 2007). El recordatorio de 24 horas, fue aplicado en dos ocasiones en días no consecutivos con el fin de salvar la estacionalidad y la variación intraindividual, el primero fue aplicado durante la estación cálida (Mayo – Septiembre) y el segundo durante la temporada de invierno (Noviembre – Marzo).

El cuestionario semicuantitativo de frecuencia de consumo de alimentos estuvo integrado por 145 ítems alimentarios (118 de la frecuencia original validada, además de alimentos característicos de las Islas Baleares, a fin de facilitar la respuesta al entrevistado); el registro de frecuencia de consumo fue organizado por grupos de alimentos (cereales, legumbres, verduras, frutas, frutos secos, lácteos, carnes, pescados, huevo, grasa, varios, bebidas y técnicas culinarias) y por los tiempos de consumo (día, semana, mes). Los

artículos consumidos de temporada también fueron considerados, mientras que los alimentos consumidos con una frecuencia <1 /mes fueron considerados como no consumo. Los cuestionarios fueron aplicados en casa de los encuestados, centro de trabajo, unidades y/o centros de salud y otros sitios públicos, con un consentimiento firmado de participación en el estudio, en el caso de los menores de 18 años, el consentimiento de participación fue firmado por sus padres o tutores. Los volúmenes y tamaños de las raciones fueron determinados aplicando las medidas caseras utilizadas en los domicilios por los propios encuestados o con la ayuda de un manual de conjunto de fotografías (Gómez *et al.* 2007). Para evitar sesgos provocados por la variabilidad del día a día, los cuestionarios fueron aplicados homogéneamente de lunes a domingo.

También fueron incluidos cuestionarios con información complementaria para la obtención de datos personales, estilos de vida, datos socioeconómicos, hábitos alimentarios, percepción corporal, antropometría, antecedentes patológicos personales y el consumo de alcohol y tabaco.

4. Índice de Masa Corporal (IMC):

Las medidas antropométricas fueron realizadas en el transcurso de la entrevista: peso, talla, perímetro de cintura, perímetro de cadera, perímetro del brazo, distancia intercondílea del húmero, pliegue tricípital, masa grasa (Kg), masa grasa (%), además de tensión arterial sistólica (TAS) y tensión arterial diastólica (TAD); también se calculó el Índice de Masa Corporal (IMC). La obtención del peso corporal se realizó con el sujeto descalzo y en ropa ligera, utilizando una balanza portátil digital (Tekal. Sc 9210, Francia) con precisión de 100 g. La medición de la talla se realizó utilizando un tallímetro portátil (Kawe 4444, Francia) con la cabeza del sujeto en el plano de Frankfurt. Se calculó el IMC (Kg/m^2) para cada individuo y la interpretación de los valores de IMC obtenidos fue de acuerdo a los puntos de corte establecidos por la Organización Mundial de la Salud (Tabla 3).

5. Patrones de consumo y hábitos alimentarios.

La evaluación de los patrones de consumo y hábitos alimentarios se realizó mediante una base de datos obtenida a partir del cuestionario de frecuencia alimentaria (FFQ) para integrar 15 grupos de alimentos de acuerdo al origen y aporte de nutrientes (carne, pescados, huevo, leche, productos lácteos, aceite de oliva, otros aceites y grasas, vegetales, frutas, frutos secos, leguminosas, patatas, cereales, pan, azúcar y bollería, bebidas azucaradas y alcohol); las raciones reportadas fueron transformadas a gramos

según el tamaño de la porción de cada alimento y posteriormente dividido entre la frecuencia de consumo.

La evaluación de la ingesta de calorías y nutrientes se basó en la información obtenida a partir de los recordatorios de 24 horas, utilizando un programa informático (Alimenta®, NUCOX, Palma España) basado en las tablas de composición de alimentos españoles (Moreiras *et al.* 2003; Mataix *et al.* 2004; Ortega *et al.* 2004), y europeos (Feinberg *et al.* 1995), y complementado con datos de composición de alimentos disponibles para los alimentos de Mallorca (Ripoll, 1992). Este programa contiene datos referentes a alimentos y platos de consumo habitual, y proporciona información sobre el contenido de 35 nutrientes además de los contenidos de energía, alcohol y agua para cada alimento y receta.

Los datos obtenidos fueron valorados de acuerdo a las guías alimentarias y objetivos nutricionales para la población española (Aranceta & Serra-Majem, 2001) y se determinaron los desequilibrios nutricionales más importantes en la población balear, así como la calidad de la dieta.

6. Índice de Calidad de la Dieta - Internacional (DQI-I).

El DQI-I fue calculado para evaluar la calidad de la dieta de Baleares, considerando cuatro aspectos principales: variedad, adecuación moderación y balance general; en cada una de estas categorías existen componentes específicos de la dieta que fueron evaluados y que permiten identificar aspectos de la dieta que necesitan mejorar. Las puntuaciones de cada componente son sumadas y representadas como el total de puntos en cada una de las cuatro categorías principales. Las puntuaciones de cada categoría fueron sumadas para obtener el puntaje total para DQI-I, el cual va de 0 a 100, donde 0 representa el valor más pobre y 100 la máxima puntuación. (Tur *et al.* 2005; Mariscal-Arcas *et al.* 2007).

7. Índice de Alimentación Saludable (HEI).

La calidad de la dieta balear se evaluó también mediante el HEI-2005, el cual incluye 12 componentes expresado en 1000 Kcal (Tabla 7), cada componente representa un valor máximo de puntos y que sumados se obtiene un total de 100 puntos (0 representa la puntuación mínima y 100 el máximo valor).

Para el cálculo del HEI, fue necesario crear la densidad de la ingesta de los grupos de alimentos que conforman los 12 componentes, para ello fue necesario que la cantidad reportada de consumo de los grupos de alimentos o nutrientes reportados en el recordatorio de 24 horas, dicha cantidad fue dividida por la energía total reportada y

multiplicada por 1000 ([total del ingesta de grupo de alimentos o nutrientes / total de ingesta de energía] * 1000) (Gunther *et al.* 2007), para posteriormente determinar la puntuación correspondiente a cada componente.

IV. RESULTADOS Y DISCUSIÓN



Manuscript I

Current food consumption habits among the Balearic Islands adult population

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Current food consumption habits among the Balearic Islands adult population

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Running title: Food consumption patterns in the Balearic Islands

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Abstract

Aims: To assess the current food consumption habits of the Balearic Islands adult population. **Methods:** A cross-sectional nutritional survey was carried out in the Balearic Islands, Spain (2009-2010). A random sample (n=1389) of the adult population (16-65 years) was interviewed. Dietary habits were assessed by means of a semi-quantitative food frequency questionnaire (FFQ), and consumption results compared with dietary guidelines for the Spanish population. **Results:** Recommendations were not fulfilled completely to any food. According to the dietary guidelines for the Spanish population, only appropriate consumption of milk and dairy products, nuts, potatoes, cereals, bread, and water. Intakes of fruit, vegetables, olive oil, eggs, and pulses are below the desirable levels. **Conclusions:** To fulfil the healthy dietary guidelines for the Spanish population, the Balearic Islands adult population should decrease the consumption of meat, sugar and cakes and soft drinks, and increase the consumption of olive oil, fruits, vegetables, fish and pulses.

Key Words: Nutritional epidemiology, food consumption, Balearic Islands.

Introduction

The assessment of food habits in a population is a basic tool to develop public health policies and to promote healthy nutritional habits in line with the evidence drawn from the epidemiological research. The periodical repetition of this assessment, let us see the trends in the compliance with nutritional objectives set for the population and also to evaluate the effectiveness of food and nutrition policies and promotion of campaigns to increase health among the inhabitants of a region or a country [1].

In Spain, the National Institute of Statistics has carried out several household budgetary surveys since the 1960's. These surveys assess the food available for the household members during a specified period of time. The Spanish Ministry of Agriculture, Fisheries and Food has also carried out several surveys and has developed a system to check a panel of consumption. Both data sets refer to food availability, but they do not provide food consumption data. A limited number of regional nutritional surveys have been carried out in Spain to assess the nutritional status of the population on a random sample, considering food consumption at individual level, anthropometric measurements and biochemical markers [2]. Since 1990, nutritional surveys among the population of several Spanish regions (Basque Country, Catalonia, Madrid, Murcia, Alicante, Canary Islands, Andalusia and Balearic Islands) have been developed, showing a progressive food diversification, changing the eating traditional habits to patterns of Western societies, and keeping scarce balanced habits [3].

From a nutritional standpoint, and therefore health related changes, the Balearic Islands inhabitants are in a peculiar situation, since their food habits are related to geographical features, food production, and the late important migratory movements, both domestic and foreign, which involve changes in dietary patterns, introducing new cooking techniques and new foods [3]. Considering all these changes and taking into account that their intensity has increased last years, the aim of this study was to assess the current food consumption habits of the Balearic Islands adult population.

Methods

Study design

The study is a population based cross-sectional nutritional survey carried out in the Balearic Islands, Spain (2009-2010).

Sample

The target population consisted of all inhabitants living in the Balearic Islands aged 16-65 years, and the sample population was derived from residents aged 16-65 years registered in the official population census of the Balearic Islands [4]. The theoretical sample size was set at 1500 individuals and the final sample was 1389 (93% participation) and the one specific relative precision of 5% (type I error = 0.05; type II error = 0.10). The sampling technique included stratification according to geographical area and municipality size, age (three strata), and sex of inhabitants, and randomisation into subgroups, with Balearic Islands municipalities being the primary sampling units, and individuals within these municipalities comprising the final sample units. Pregnant women were not considered in this study.

Assessment of food consumption habits

Dietary questionnaires and global questionnaire incorporating questions related to socioeconomic status, education level and life-style factors were utilized. A semi-quantitative food frequency questionnaire (FFQ) previously validated [5] and applied to other studies and surveys over the Spanish population [3,6-10]. The FFQ evaluated average consumption over the past year of 145 items (118 of the original validated FFQ plus the most characteristic Balearic Islands foods in order to make easy the interviewee answer), and arranged by food type and meal pattern. Frequency of food consumption was based on times that food items were consumed (per day, week or month). Consumption <1/month was considered no consumption. Daily consumption (g) was determined by dividing the reported amount of the intake by the frequency (d). The period of consumption of seasonal items was also considered.

Volumes and portion sizes were reported in natural units, household measures or with the aid of a manual of sets of photographs [11]. Consumption results were compared with dietary guidelines for the Spanish population [12].

Statistics

Analyses were performed with SPSS version 19.0. To correct age and sex under- and overrepresentation in the sample, sex and age weights were calculated and appropriate corrections were made proportionally to the population census [4]. Mean values and SEM are shown. Differences between means were performed by ANOVA one-way test. Sequential Bonferroni's test was applied to control type-I error [13]. Percentage of population that met the recommendations stratified by age group and sex was tested by χ^2 .

Ethics

The present study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects were approved by the Balearic Islands Ethics Committee. Written informed consent was obtained from all subjects and their parents or legal tutors.

Results

Table 1 shows the distribution of the sample. The final sample size was 1388 individuals (93% participation). Non-participation rates included potential subjects declining to be interviewed as well as involuntary non-participation due to census error caused by address changes, missing persons or unavoidable impediments to survey collaboration.

Table 2 shows the average consumption by food group in males and females (g/day), and Table 3 shows mean consumption by food group and age group. The foods consumed in higher amounts by the Balearic Islands adult population are fruit, milk, dairy products, vegetables, meat, cereals, and soft drinks. Men had significantly higher consumption of meat, eggs, milk, dairy products, other oils and fats, nuts,

cereals, bread, sugar and cakes, soft drinks, and alcoholic drinks. Women had significantly higher consumption of olive oil and vegetables. Consumption of fermented alcoholic drinks (wine and beer, ml/person/day, mean \pm SEM) was 122.8 ± 10.0 in men and 76.2 ± 4.3 in women ($P < 0.001$), whereas consumption of distilled alcoholic drinks (ml/person/day, mean \pm SEM) was 10.1 ± 0.9 in men and 5.6 ± 0.5 in women ($P < 0.001$). Younger subjects had higher intakes of meat, milk, dairy products, other oils and fats, potatoes, cereals, sugar and cakes, and soft drinks. Subjects aged 26-45 years also showed a significant higher intake of fish and alcoholic drinks, and lower intake of milk. Subjects aged 46-65 years showed a significant higher intake of vegetables, fruit, olive oil, nuts, and bread, and lower intake of meat, other oils and fats, potatoes, cereals, sugar and cakes, and soft drinks. Consumption of fermented alcoholic drinks (ml/person/day, mean \pm SEM) was 74.7 ± 6.9 in 16-25 year old subjects, 115.6 ± 6.9 in 25-45 year old participants, and 101.6 ± 10.7 in 45-65 year old persons ($P < 0.001$), whereas consumption of distilled alcoholic drinks (ml/person/day, mean \pm SEM) was 10.6 ± 0.8 in 16-25 year old subjects, 5.7 ± 0.6 in 25-45 year old participants, and 4.1 ± 0.8 in 45-65 year old persons ($P < 0.001$).

Table 4 shows the percentage of Balearic Islands adult population that met the recommendations, stratified by sex and age. Recommendations were not fulfilled completely to any food. Highest percentages of population that met recommendations were achieved for sugar and cakes, soft drinks, and alcoholic drinks, and the lowest were registered for vegetables, pulses, nuts, fruit, olive oil, potatoes, cereals and bread, other oils and fats, and meat, fish and eggs. Younger men and women showed lowest compliance for milk and dairy products, olive oil, other oils and fats, vegetables, and fruit.

Table 5 shows current frequency of consumption (servings/day) of Balearic Islands adult population (16-65 years) in comparison with the Spanish Food Guide Pyramid [12]. According to these recommendations, the Balearic Islands adult population showed lower consumption of vegetables, fruit, oil olive and pulses, and higher consumption of foods comprised in fifth and seventh level of Spanish Food Guide Pyramid. The water consumption followed the recommendations.

Discussion

The high participation rate (93%) in this study is representative of the Balearic Islands adult population (16-65 years). The participation rate was higher than nutritional surveys previously carried out in Spain (60-80%) [3,6-10].

The current food consumption habits of the Balearic Islands adult population are characterized by a high consumption of milk and dairy products, vegetables, fruit, cereals and bread, meat, fish, and soft drinks. When this food consumption habits are compared to results for the overall Spanish population, the Balearic Islands inhabitants show higher consumption (g/person/day) of fish, milk and dairy products, nuts, sugar and cakes, but lower of eggs, olive oil, and alcoholic drinks than the average food consumption in Spain [14,15]. In terms of food frequency on a daily basis, Balearic Islands inhabitants showed higher servings of animal products, milk and dairy products, cereals and potatoes, nuts than those of Spanish people [14,15].

According to the dietary guidelines for the Spanish population [12], only appropriate consumption of milk and dairy products, nuts, potatoes, cereals, bread, and water. Intakes of fruit, vegetables, olive oil, eggs, and pulses are below the desirable levels. Women outnumbered men in the consumption of olive oil and vegetables. When the age of subjects was considered, the consumption of meat, milk, dairy products, other oils and fats, potatoes, cereals, sugar and cakes, and soft drinks was highest in 16-25 year old subjects, and decreased in 45-65 year old subjects. Conversely, the consumption of fish, olive oil, vegetables, fruit, nuts and bread was lowest in younger subjects, and increased in the older subjects. These results agree with previous studies [1,10].

Alcohol intake is also high; however, in the context of the Mediterranean diet (taking into consideration the prevalent habit of drinking wine or other fermented alcoholic drinks with meals) moderate consumption of alcohol is generally well accepted because of the likely healthy properties of polyphenols and other phytochemicals contained in these drinks. The consumption of wine and other fermented alcoholic drinks should not be generalized as a public health strategy, as part of its beneficial effects can be obtained from grapes and their must. Additionally, alcohol

consumption may compromise health under given circumstances (driving, pregnancy, addiction). However, a moderate consumption of fermented alcoholic drinks is considered permissible if limited to 250-400 ml.d-1 (not more than two glasses of wine a day or equivalent amounts of other fermented beverages), and if taken with meals; for women, consumption levels should be somewhat lower [12,16]. Accordingly, main consumption of alcoholic drinks in the Balearic Islands appears mainly in the form of wine and beer, and its consumption in both men and women is below the limits. However, consumption of wine and beer is higher in >25 year old subjects, whereas younger participants (16-25 year old) show the highest consumption of distilled alcoholic drinks, mainly on weekends (data not shown).

Since the last cross-sectional nutritional survey carried out in 1999-2000 [3], the Balearic Islands adult population at least has doubled the consumption of animal products (from 1.2 to 2.8 servings/day), sugar and cakes (from 1.2 to 2.7 servings/day), cereals (from 0.7 to 2.9 servings/day), and soft drinks (from 0.3 to 2.6 servings/day). This population has also decreased the consumption of olive oil (from 3.0 to 1.8 servings/day), bread (from 3.0 to 2.2 servings/day), and alcohol (from 1.0 to 0.5 servings/day), slightly increased milk and dairy products (from 2.0 to 2.7 servings/day), fruits (from 1.3 to 1.9 servings/day), and maintained the consumption of nuts (from 0.5 to 0.3 servings/day), pulses (from 0.1 to 0.2 servings/day), vegetables (from 1.2 to 1.1 servings/day), potatoes (from 0.2 to 0.3 servings/day), and other oils and fats (from 0.7 to 0.6 servings/day).

In comparison with the average daily rations of the Spanish Food Guide Pyramid [12], it was observed that foods included in the first level (potatoes, cereals and bread) reflect a positive change because the current intake followed the recommendations. However, the second level of the Pyramid showed an inadequate intake of vegetables and fruit (3 servings/day), which has been also reflected in other epidemiological studies [1,14,17,18]. A low intake of vegetables and fruit are aspects of unhealthy food habits, but also reflects a poor adherence to the Mediterranean diet [1,14,17,18].

At the third level, the average consumption of milk and dairy products follows the recommendations, but olive oil was poorly consumed less than the recommendations,

however the percentage of consumers is still higher compared to the consumption of other fats and oils. Since the olive oil consumption is beneficial for health [19,20], it has been recommended to improve the quality of fat consumed, principally through the incorporation of olive or other oils rich in monounsaturated fatty acids, overall moderating fat intake [16]. Moreover, the establishment of nutritional recommendations for a country or a region, such as the Mediterranean, should be carried out with full knowledge of the dietary patterns and nutritional status of the target population and as such, should acknowledge existing food idiosyncrasies and gastronomy of the region [21]. Therefore, a desirable increment of olive oil and a decreased consumption of animal fats should be promoted among the Balearic Islands adult population.

At the fourth level, it has been showed low pulses consumption, high meat consumption, and adequate fish consumption. At the fifth level, the Balearic Islands adult population follows the recommendations [12], with a moderate consumption of butchery products. At the sixth level, the data reflects an average consumption of 3 occasions/day of sugar and cakes and soft drinks, which are below the Spanish Food Guide Pyramid recommendations [12], but it would be greatly desirable to decrease it.

These results are in agreement with previous data that suggest dietary patterns are changing rapidly in Mediterranean countries, with increased consumption of animal products and saturated fat and the detriment of basic foodstuffs on a vegetable basis [3,22]. Differences in food habits among age groups show more drastic changes among younger ages, whereas older people still maintain a diet more in line with the traditional Balearic, and hence Mediterranean, food habits [3,23]. All of which agrees with the percentages of the population met the recommendations for foods.

Conclusions

The Balearic Islands adult population must decrease the consumption of meat, sugar and cakes and soft drinks, and increase the consumption of olive oil, fruits, vegetables, fish and pulses, to fulfil the healthy dietary guidelines suggested by the Spanish Society of Community Nutrition [12].

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References

1. Serra Majem LI, Ribas Barba L, Salvador Castell G, Roman Vinas B, Castell Abat C, Cabezas Pena C, Pastor Ferrer MC, Raido Quintana B, Ngo de la Cruz J, García Álvarez A, Serra Farro J, Salleras Sanmarti L, Taradach Antoni P: Trends in the nutritional status of the Spanish population: results from the Catalan nutrition monitoring system (1992- 2003). *Rev Esp Salud Pública* 2007; 81:559-570.
2. Aranceta J, Perez Rodrigo C, Eguileor I, Marzana I, Gonzalez de Galdeano L, Saenz de Buruaga J: Food consumption patterns in the adult population of the Basque Country (EINUT-I). *Public Health Nutr* 1998;1:185-192.
3. Tur JA, Romaguera D, Pons A: Food Consumption Patterns in a Mediterranean Region: Does the Mediterranean Diet Still Exist? *Ann Nutr Metab* 2004; 48:193-201.
4. Institut d'Estadística de les Illes Balears (IBESTAT). <http://www.ibestat.es/> (accessed April 2011).
5. Martin-Moreno JM, Boyle P, Gorgojo L, , Maisonneuve P, Fernandez-Rodriguez JC, Salvini S, Willett WC: Development and validation of a food frequency questionnaire in Spain. *Int J Epidemiol* 1993; 22:512-519.
6. Aranceta J, Pérez C, Gondra J, González de Galdeano L, Saenz de Buruaga J: Fat and alcohol intake in the Basque Country. *Eur J Clin Nutr* 1993; 47 Suppl 1:S66-S70.
7. Serra LI, Ribas L: *Nutritional Survey of Catalonia (1992–1993)*. Barcelona, Generalitat de Catalunya, Departament de Sanitat i Seguretat Social, 1996.
8. Serra-Majem LI (ed): *Nutritional Survey of Canary Islands (1997–1998)*. Las Palmas de Gran Canaria, Servicio Canario de Salud, 2000.

9. Garcia-Closas R, Berenguer A, Tormo MJ, Sánchez MJ, Quiros JR, Navarro C, Arnaud R, Dorronsoro M, Chirlaque MD, Barricarte A, Ardanaz E, Amiano P, Martínez C, Agudo A, González CA: Dietary sources of vitamin C, vitamin E and specific carotenoids in Spain. *Br J Nutr* 2004; 91:1005-1011.
10. Ribas-Barba L, Serra-Majem L, Salvador G, Castell C, Cabezas C, Salleras L, Plasencia A: Trends in dietary habits and food consumption in Catalonia, Spain (1992–2003). *Public Health Nutr* 2007; 10:1340-1353.
11. Gómez C, Kohen VL, Nogueira TL: *Guía visual de alimentos y raciones*. Madrid: EDIMSA, 2007.
12. Aranceta J, Serra-Majem L: Dietary guidelines for the Spanish population. *Public Health Nutr* 2001;4:1403-1408.
13. Holm S: A simple sequentially rejective multiple test procedure. *Scand J Stat* 1979;6:65-70.
14. Aranceta J: Spanish food patterns. *Public Health Nutr* 2001; 4:1399–1402.
15. Aranceta J, Serra-Majem Ll, Perez-Rodrigo C, Llopis J, Mataix J, Ribas L, Tojo R, Tur JA: Vitamins in Spanish food patterns: The eVe Study. *Public Health Nutr* 2001; 4:1317–1323.
16. Serra-Majem Ll, Aranceta J: Nutritional objectives for the Spanish population. Consensus from the Spanish Society of Community Nutrition. *Public Health Nutr* 2001;4:1409–1413.

17. Nasreddine L, Hwalla N, Sibai A, Hamze M, Parent-Massin D: Food consumption patterns in an adult urban population in Beirut, Lebanon. *Public Health Nutr* 2006; 9:194-203.
18. Ribas-Barba L, Serra-Majem L, Salvador G, Castell C, Cabezas C, Salleras L, Plasencia A: Trends in dietary habits and food consumption in Catalonia, Spain (1992–2003). *Public Health Nutr* 2007;10:1340-1353.
19. Serra-Majem LL, Ngo de la Cruz J, L Ribas, Tur JA: Olive oil and the Mediterranean diet: beyond the rhetoric. *Eur J Clin Nutr* 2003;57(Suppl. 1):S2-S7.
20. Tur JA: La calidad de la grasa: El aceite de oliva. *Arch Latinoam Nutr* 2004;54(Suppl.1):59-64.
21. Serra-Majem L, Ferro-Luzzi A, Bellizzi MC, Salleras L: Nutrition policies in Mediterranean Europe. *Nutr Rev* 1997;55(Suppl. II):S39 -S54.
22. Rumm-Kreuter D: Comparison of the eating and cooking habits of northern Europe and the Mediterranean countries in the past, present and future. *Int J Vitam Nutr Res* 2001; 71:141-148.
23. Tur JA, Llado M, Alberti RC, Pons A: Changes on nutrient and food intakes in Mallorca throughout the 20th century (in Spanish). *Rev Esp Nutr Comunitaria* 2004; 10:6-16.

Table 1. Characteristics of the sample.

Age group	Men (n = 581)		Women (n = 807)		Total (n = 1388)	
	n	%	n	%	n	%
16 – 25 years	306	51.1	293	48.9	599	43.2
26 – 45 years	201	35.8	360	64.2	561	40.4
46 – 65 years	74	32.5	154	67.5	228	16.4

Table 2. Food consumption habits in the Balearic Islands adult population as frequency of consumption (g/day) and percentage of usual consumers by sex.

Food Group	MEN (n=581)		WOMEN (n = 807)		P	ALL (n=1388)		Portion size (net raw weight)
	(Mean ± SEM)	P ₅₀	(Mean ± SEM)	P ₅₀		(Mean ± SEM)	P ₅₀	
Meat	152.7 ± 5.2	128.3	139.9 ± 4.4	116.7	0.009	145.3 ± 3.4	119.4	100 - 125 g
Fish	95.2 ± 3.5	74.3	89.4 ± 3.0	75	0.401	91.9 ± 2.3	74.3	125 - 150 g
Eggs	23.2 ± 1.1	15.7	17.5 ± 0.9	15.4	0.001	19.9 ± 0.7	15.5	55 g
Milk	262.6 ± 8.9	225	243.8 ± 7.6	220	0.043	251.7 ± 5.7	222	200 - 250 g
Dairy products	216.5 ± 7.5	180	209.4 ± 6.4	170.9	0.358	212.3 ± 4.8	171	Yogurt (200 - 250 g) cheese (40-60 g)
Olive oil	17.0 ± 0.7	10	18.8 ± 0.6	12	0.001	18.1 ± 0.5	10	10 ml
Other oil and fats	11.5 ± 0.7	6.4	9.7 ± 0.6	4.3	0.003	10.5 ± 0.5	5.4	10 g or ml
Vegetables	132.3 ± 6.0	107.1	180.0 ± 5.1	152.5	0.001	160.0 ± 4.0	150	150 g
Fruit	278.0 ± 9.0	208.6	282.5 ± 7.6	205.3	0.265	276.9 ± 5.9	232.9	136 g
Nuts	11.7 ± 0.8	4.3	8.9 ± 0.7	4.3	0.019	10.1 ± 0.5	4.3	30 g
Pulses	34.7 ± 1.9	21.4	33.2 ± 1.6	20.4	0.32	33.8 ± 1.2	21.4	150 200 g (cooked weight)
Potatoes	66.3 ± 2.9	57.1	62.2 ± 2.4	56.1	0.145	63.1 ± 1.8	57.1	200 g
Cereals	141.0 ± 4.2	122	122.0 ± 3.6	98.6	0.001	129.4 ± 2.7	106.5	120 g
Bread	83.6 ± 2.6	65	61.6 ± 2.2	59	0.001	70.2 ± 1.7	60	35 g
Sugar and cakes	46.2 ± 38.9	32.2	38.9 ± 1.6	29.6	0.001	42.0 ± 1.2	30.8	10 g (sugar), 30-50 g (cakes)
Soft drinks	462.0 ± 19.7	305.3	397.2 ± 16.6	250	0.004	419.1 ± 12.7	266.4	300 ml
Alcoholic drinks	129.0 ± 7.4	30.7	71.2 ± 6.3	18.4	0.001	94.5 ± 4.8	21.2	200 ml (fermented), 60 ml (distilled)

Mean ± SEM (Standard Error of Mean). Significant differences between men and women by ANOVA one-way test corrected by sequential Bonferroni's test to control type-I error. P₅₀: Median or Percentile 50.

Table 3. Food consumption habits in the Balearic Islands adult population as frequency of consumption (g/day) and percentage of usual consumers by age group.

Food Group	16-25 y (n=599)		26-45 y (n=561)		46-65 y (n=228)		P	Portion size (net raw weight)
	(Mean ± SEM)	P ₅₀	(Mean ± SEM)	P ₅₀	(Mean ± SEM)	P ₅₀		
Meat	164.5 ± 6.8 ^a	129.8	136.8 ± 3.8 ^b	116.2	114.6 ± 3.7 ^b	107.9	0.001	100 - 125 g
Fish	85.2 ± 3.9 ^a	64.3	98.5 ± 3.4 ^b	84.3	93.3 ± 4.0 ^b	79.3	0.025	125 - 150 g
Eggs	20.6 ± 1.4	15.7	19.5 ± 0.7	15.6	18.8 ± 1.0	15.4	0.624	55 g
Milk	273.1 ± 9.8 ^a	225	233.0 ± 7.9 ^b	215	241.3 ± 12.7	220	0.004	200 - 250 g
Dairy products	223.8 ± 8.3	171.4	204.4 ± 6.7	174	203.8 ± 10.7	180.9	0.137	Yogurt (200 - 250 g) cheese (40-60 g)
Olive oil	11.8 ± 0.6 ^a	10	22.8 ± 0.8 ^b	20	23.0 ± 1.2 ^b	20	0.001	10 ml
Other oil and fats	14.3 ± 0.9 ^a	8.6	8.6 ± 0.5 ^b	4.3	5.1 ± 0.5 ^c	2.1	0.001	10 g or ml
Vegetables	130.9 ± 6.2 ^a	90.4	181.7 ± 6.3 ^b	150	183.8 ± 7.2 ^b	171.4	0.001	150g
Fruit	234.1 ± 8.4 ^a	164.6	287.8 ± 9.2 ^b	260	362.6 ± 15.3 ^c	332	0.001	136 g
Nuts	9.1 ± 0.9	4.3	10.3 ± 0.8	4.3	12.2 ± 1.0	8.6	0.107	30 g
Pulses	30.4 ± 2.5 ^a	21.4	30.2 ± 1.3 ^b	20.4	30.6 ± 1.5	20.4	0.075	150 200 g (cooked weight)
Potatoes	72.9 ± 3.6 ^a	67.1	58.0 ± 2.1 ^b	57.1	52.8 ± 2.9 ^b	98.9	0.001	200 g
Cereals	142.8 ± 4.8 ^a	113.5	125.3 ± 3.9 ^b	106.7	107.6 ± 4.5 ^b	65.4	0.001	120 g
Bread	69.0 ± 2.5 ^a	60	69.0 ± 2.4 ^b	60	80.2 ± 5.1 ^b	26.4	0.045	35 g
Sugar and cakes	48.3 ± 2.2 ^a	34	39.4 ± 1.6 ^b	30.3	31.5 ± 1.9 ^b	26.4	0.001	10 g (sugar), 30-50 g (cakes)
Soft drinks	465.6 ± 20.4 ^a	330	403.0 ± 19.3 ^b	255	335.5 ± 28.0 ^b	200	0.001	300 ml
Alcoholic drinks	78.4 ± 6.4 ^a	14.3	111.6 ± 8.6 ^b	34.3	94.4 ± 10.8 ^b	22.4	0.007	200 ml (fermented), 60 ml (distilled)

Mean ± SEM (Standard Error of Mean). Results were adjusted by sex. Differences between age groups by ANOVA one-way test corrected by sequential Bonferroni's test to control type-I error. Different letters indicate significant different values. P₅₀: Median or percentile 50.

Table 4 Percentage of Balearic Islands adult population that met the recommendations stratified sex and age.

	Men			P	Women			P	RDS
	16-25 years (n=306)	26-45 years (n=201)	46-65 years (n=74)		16-25 years (n=293)	26-45 years (n=360)	46-65 years (n=154)		
Meat, fish & eggs	31.7	35.9	33.8	0.08	32.4	33.9	41.4	0.121	2
Milk & dairy products	51.6	51.2	52.1	0.001	53.3	56.6	66.9	0.015	2 to 4
Olive oil	21.6	48.8	34.1	0.001	29	51.1	58.4	0.001	3 to 5
Other oil & fats	8.1	17.6	34.3	0.001	12.3	17.3	25.4	0.001	Occ.
Vegetables	7.2	7	10.8	0.528	11.6	23.3	21.4	0.001	? 2
Fruit	18	25.4	33.8	0.007	16	29.2	46.8	0.001	? 3
Nuts	14.1	19.9	17.6	0.215	12.6	15.6	11.7	0.396	0.14
Pulses	7.5	7	8.1	0.406	6.1	7.2	6.2	0.314	0.43
Potatoes, cereals & bread	29.4	26.4	25.7	0.618	23.6	25.6	25	0.69	4 to 6
Sugar & cakes	76.1	85.1	86.5	0.018	78.8	83.6	89	0.02	Occ.
Soft drinks	81.7	79.1	82.4	0.72	83.6	79.4	84.4	0.258	Occ.
Alcoholic drinks	93.1	92.5	89.2	0.544	98	96.7	97.4	0.601	Occ.

Percentage of population that met the recommendations stratified by age group and sex was tested by χ^2 .

RDS = Recommended daily serving (frequency of consumption) [12]. Occ. = Occasionally.

Table 5. Current intake of the Balearic Islands adult population (16-65 years) compared with the Spanish Food Guide Pyramid*.

Frequency category	Foods included in each level	Recommended frequency of consumption	Current frequency of consumption (servings/day)	Portion size (net raw weight)	Household measures
DAILY CONSUMPTION	First level (pyramid base):				
	Potatoes, rice bread, whole-bread, pasta, a variety of flours cereals	4-6 servings per day	5	60-80 g pasta, 40-60 g bread, 150-200 g potatoes	1 average plate, 3- slices or a roll, 1 big potato or 2 small ones
	Water	4-8 servings per day	6	200 ml approx.	1 glass or 1 small
	Second level:				
	Vegetables (lettuce, tomatoes, carrots, cauliflower, leeks, onions, etc.)	> 2 servings per day	1?	150-200 g	1 plate of assorted, 1 plate of cooked vegetables, 1 big tomato, 2 carrots, Side dishes can for ½ serving
	Fruits (oranges, apples, pears, grapes, strawberries, etc.)	≥ 3 servings per day	2 ?	120-200 g	1 medium piece/1 cup of cherries, Strawberries, etc./2 slices of melon
	Third level (upper level):				
	Milk, dairy products (yoghurt, cheese, fresh cheese, cottage cheese, etc.)	2-4 serving per day	3	200-250 ml milk, 200-250 g, 40-60 g mature cheese	1 cup of milk, 2 units of yoghurt, 2-3 slices of cheese
	Olive oil	3-5 servings per day	2 ?	10 ml	1 spoonful
	Encouraging to practice daily physical activity	Daily	≥ 30	≥ 30 minutes	
WEEKLY CONSUMPTION	Fourth level (upper level):				
	Fish	Alternate between them	1	125-150 g (net weight)	1 individual fillet, 2-3 slices of fish
	Lean meat, poultry and eggs		2	100-125 g (net weight)	1 small fillet, 1 leg, ¼ rabbit, 1-2 eggs
	Pulses (beans, chick peas, soy, etc)	2-3 serving weekly of legumes	0.23 ?	60-80 g	1 individual plate (150 – 200 g cooked weight)
	Nuts		2	20-30 g	1 handful or pack
OCCASIONAL CONSUMPTION	Fifth level: Butchery products and fatty meats	Occasionally	0.64	-	Moderate
	Sixth level: Sweets, cakes, or salted snacks, sugary soft	<4 occasions per day	3	-	Moderate
	Seventh level: Butter, manufactured cakes, buns	Occasionally	1	-	Moderate

*The Spanish Food Pyramid by the Spanish Society of Community Nutrition (SENC) [17].

? = Below recommended frequency of consumption.

Manuscript II

Patterns of food consumption current of the adult population of the Balearic Islands. Does it comply with dietary guidelines WHO / FAO?

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Patterns of food consumption current of the adult population of the Balearic Islands. Does it comply with dietary guidelines WHO/FAO?

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Running title: Food consumption patterns

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Key Words

Nutrition survey · Food group · Food consumption · Food pattern · Common targets - Balearic Islands

Abstract:

Aims: Identify differences between current patterns of food consumption and intake among the adult population of the Balearic Islands, according to the WHO/FAO food guide dietary factors and the common goals of public health nutrition, fatty acids (FAT), saturated fatty acids (SFA), fruits and vegetables (F&V) and dietary fiber. **Methods:** A cross-sectional nutritional survey was carried out in the Balearic Islands between 2009 and 2010. A random sample ($n = 1,389$) of the adult population (16 – 65 years) was interviewed. Dietary habits were assessed by means two 24 hours diet recall and a semi-quantitative food frequency questionnaire (FFQ). **Results:** The foods that represented the largest percentage of intake, were the bread, raw vegetables, fresh fruit, skim milk, yogurt, white meat, (chicken and fish), olive oil, salad dressings, soft drinks and beer; According to the WHO/FAO food guide dietary factors, women showed significantly higher consumption ($p < 0.05$) of total fatty acids, monounsaturated and polyunsaturated fatty acids, cholesterol, fruits and vegetables, than men. The average values of consumption for the WHO/FAO food guide dietary factors show significant differences between the lowest and highest quartile of common nutritional target of public health, FAT (% energy), SFA (% energy), F&V (g/d) and dietary fiber (g/d), were significantly different between the lowest and highest quartile ($p < 0.05$). Thus, a difference of twice as high in fruit and vegetables intake among categories of low and high quartile of fiber intake (373.51 g/d vs. 632.64 g/d, $p < 0.05$) was observed; a similar trend in the lowest and highest quartile of fruit and vegetables on dietary fiber consumption (14.80 g/d vs. 20.16 g/d, $p < 0.05$) was found. **Conclusions:** Adherence to dietary guidelines and common objectives of public health in the adult population of the Balearic Island is low, therefore we need a detailed analysis of current eating patterns to improve intervention strategies and improve adherence to these guidelines, allowing address step by step the differences between eating habits and ideal diet, with the aim of improving nutritional intervention policies, retaining most of the characteristic of a healthy Mediterranean diet.

Introduction

The quality of the diet contributes to the delay or prevention of a number of chronic diseases, which have been the main cause of morbidity and mortality Worldwide. The role of the various components of the diet and food combinations, have been the subject of various investigations [Tur JA *et al.* 2004; Song-Yi Park *et al.* 2004]. For example a low consumption of fruit and vegetables and high risk of cardiovascular disease and other chronic disease (cancer, diabetes, obesity and associated diseases) [Sharma S *et al.* 2007]. This has proven to be common in both Eastern Europe, the former Soviet Union and other countries [Boylan S *et al.* 2009].

The WHO/FAO food guide dietary, are the most practical way to achieve nutritional goals, incorporating certain nutritional concerns and take into account customary dietary patterns, socioeconomic factors and cultural biological and physical environment in which people live. They are also consistent with the policies and programs aimed at improving the supply of food and nutrition, and are flexible for different age groups, lifestyles and physiological conditions [Clay WD. 1997].

The Eating patterns of the Spanish population have changed dramatically in the last 40 years, which currently differ from the traditional mediterranean diet and healthy, especially in young populations, with a decrease in the consumption of fish, fruits and vegetables and increased consumption of saturated fat and pastries [Serra-Majem L *et al.* 2007]. A favorable diet is characterized by a high consumption of fruits, vegetables and grain products rich in fiber and low in fat and refined sugar. A diet rich in saturated fat and sugar but low in fiber, fruits and vegetables is considered unfavorable [Tur JA & Romaguera D. 2004]. The developments of new strategies are needed to improve nutrient intake in the population, by analyzing patterns of consumption or through other existing analysis of food intake and nutrient. Secondly through strategies and objectives of health intervention and public health promotion to reduce the average risk to the health of all people, and achieve optimal health and wellness. This objective requires the development of food and nutrition policies aimed at the health of the whole community, eliminating or reducing risk factors found [Serra Majem, Ll *et al.* 2007; Ribas-Barba L *et al.* 2007; Tur JA & Romaguera D, 2004].

Nutrition Survey 2009 – 2010, applied to the adult population of the Balearic Island was used in order to identify differences between the current patterns of food consumption and nutrient intake among the adult population of the Balearic Island, according with

the WHO/FAO food guide dietary factors and the common goals of public health nutrition, through sub-classification of consumption in the first and fourth quartiles of daily intake of FAT (% energy), SFA (% energy), F & V (g/d) and dietary fiber (g/d).

Methods

Study design

Cross-sectional nutritional survey carried out in the Balearic Islands between 2009 and 2010.

Sample

The target population consisted of all inhabitants living in the Balearic Islands aged 16 - 65 years, and the sample population was derived from residents aged 16-65 years registered in the official population census of the Balearic Island. The theoretical sample size was set at 1,500 individuals and the final sample was 1,389 (93% participation).

Questionnaires

Dietary questionnaires and global questionnaire incorporating questions related to socio-economic status, education level and life-style factors were utilized. The dietary questionnaires included two 24-hours diet recalls and a semi-quantitative food frequency questionnaire (FFQ). FFQ was previously validated [Martin-Moreno JM *et al.* 1993] and applied to other studies and surveys over the Spanish population [Tur JA & Romaguera D, 2004; Serra-Majem L *et al.* 1994; Bondia-Pons I *et al.* 2007]. The FFQ, which asked the subject to recall average use over the past year, consisted of 145 items (118 of the original validated FFQ plus the most characteristic Balearic Islands foods in order to make easy the interviewee answer), and arranged by food type and meal pattern. Frequency of food consumption was based on times that food items were consumed (per day, week or month). Consumption <1/month was considered no consumption. Daily consumption (g) was determined by dividing the reported amount of the intake by the frequency (d). The period of consumption of seasonal items was also considered. Edible fractions of foods were recorded in the database [Martin-Moreno JM *et al.* 1993; Serra-Majem L *et al.* 1994; Bondia-Pons I *et al.* 2007].

The questionnaires were administered in the subject's home, area work, health centre or other public site. To avoid bias brought on by day-to-day intake variability, the

questionnaires were administered homogeneously from Monday to Sunday. In order to estimated volumes and portion sizes, the household measures found in the subject's own homes were used. Conversion of food into nutrients was made using a self-made computerized program based on Spanish [Moreiras O *et al.* 2003; Mataix J *et al.* 2004] and European [Feinberg M *et al.* 1995]. Food Composition Tables and complemented with food composition data available for Majorcan food items [Ripoll L. 1992].

Statistics

Analyses were performed with SPSS version 17.0. The contribution of each subgroup intake for each food group was weighted. The proportion of compliers with the WHO/FAO food guide dietary factors, were calculated by chi-square test and stratified by sex. Feeding patterns and nutrient intake and compliance with nutritional objectives, were compared between highest and lowest quartile by ANCOVA and adjusted by energy intake, sex and age. The level of significance was established for *P* values <0.05.

Ethics

The present study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects were approved by the Balearic Islands Ethics Committee. Written informed consent was obtained from all subjects and their parents or legal tutors

Results

Table 1 Shows the distribution of food sources of the food groups according to food Guide Pyramid, in descending order by percentage contribution to the intake of the adult population of Balearic Island. As presented, the total contribution of the cereal group, 48.3 % corresponds to bread, 22.4% pasta and 21.0 % for rice. The vegetable group 61.4% corresponds to raw vegetables and 38.6% to cooked vegetables, fruits 75.8 % corresponds to natural fruit and 21.3 % to natural fruit juice. Dairy groups, skim milk represents the largest contribution 44.0%, while whole milk with 33.0 % and skimmed milk 23.0%; of dairy products 61.0 % is contributed by yogurt and 26.8% for cheese varieties. In the meat group shows that 34.0 % corresponds to eggs, 21.0 % to chicken, 19.0 % to fish and 16.0 % to pig. Oil group 90.5% corresponds to olive oil and 9.5% to other oils such as sunflower, corn and soybean. Other fats, the 48.0% corresponds to addressing 28.0% to bacon and 24.0% to butter. In the group of sugar and cakes 29.6%

corresponds to cakes, 19.9% other sugar such as jam, honey and cocoa. Of sweet drinks 35.7% corresponds to refreshments, 24.0% to commercial juice, 19.1% to coffee and 19.0% some kind of tea. Of beverages containing alcohol 41.3% corresponds to beer, 26.8% to alcoholic beverages and 24.9% to table wines.

Table 2 Shows the percentage of compliers with the WHO/FAO food guide dietary in adult population and men and women. The compliance rate in the recommended ranges of WHO/FAO food guide dietary factors the adult population the Balearic Island was low. Only 18.3% met the recommendation for total fat, 11.2% to carbohydrates and 32.9% to protein. The compliance of the recommendation of SFA was 31.2%, MUFA's from 38.5% and with lower PUFA's with 11.8%, while for cholesterol, 52.5% of the population followed the recommendation. Similar behavior was observed for fruits and vegetables (52.0%), while complying with the recommendation of fiber and sodium was 16.2% and 0.2% respectively.

When comparing the implementation of the recommendations for men and women, the results showed that women have a significantly higher consumption of SFA, MUFA's, PUFA's, cholesterol, and fruits and vegetables ($p < 0.05$); while men no significant differences in total fat intake, protein and sodium, but consumed more dietary fiber than women (18.9% y 14.4% respectively).

Table 3 Show mean intake value for the WHO/FAO food guide dietary factors classified according to the lowest and highest quartiles of common nutritional target of public health in adult population of Balearic Island. As presented, after adjusting the values for total energy intake, sex and age, all WHO/FAO food guide dietary factors, were significantly different between the lowest and highest quartile of total consumption of FAT and SFA with the exception of sodium, fruit and vegetables for intake FAT. The factors below the lower quartile values about the highest quartile of intake of SFA and SFA were FAT, SFA, MUFAs, PUFAs (except in SFA, which was significantly greater in the lowest quartile) and cholesterol. In contrast, in the lowest quartile there was an increased consumption of carbohydrates, protein and dietary fiber that in the highest quartile. Sodium is significantly different between the lowest and highest quartile of SFA, the first quartile was lower compared to the largest quartile.

As presented, there is a difference of two times higher in fruit and vegetables consumption among the categories of minor and major quartile of fiber intake (373.51 g/d vs. 632.64 g/d, $p < 0.05$); a similar trends is observed in the lowest and highest quartile of fruit and vegetables on dietary fiber consumption (14.80 g/d vs. 20.16 g/d, $p < 0.05$).

Discusión

This study provides insight into the compliance the WHO/FAO food guide dietary factor and compliance with the common goals of public health nutrition. Considering the levels and food groups and food guide pyramid, was observed that make up the base of the pyramid, which includes cereals and grains, the bread is mostly consumed followed by pasta and rice and other cereals (including breakfast cereal). This behavior in the decrease in consumption of whole grains, and increased consumption of bread is also observed in the United States population [Cleveland LE., et al. 2000]. Regarding the second level of the pyramid, vegetables and fruit, raw vegetables are the most consumed followed of the cooked vegetables, however, in the same study showed that current intake of vegetables the serving/day (RDS) is decreased, of ≥ 2 serving/day at current consumption of 1 serving/day (data not shown) [Serra Majem, Ll *et al.* 2007]. This group food are included primarily in foods such as salads and/or fitting, a characteristic of the Mediterranean diet. In the case of fruit, there was an increased consumption of fresh fruit, followed by fresh fruit juice dried fruits or dried, with a behavior similar to plants in the RDS as well have a slight reduction in consumption (data not shown) [Serra Majem L *et al.* 2007]. In the third level of the pyramid, milk and dairy products, was observed that both low fat and skim milk are mainly consumed in a second whole milk. About dairy products is the yogurt which shows a higher percentage of contribution to the continued intake of the different varieties of cheese and flan, but with minor variations in order of consumption. Other Studies show increased consumption of whole and skim milk, cheese and yogurt [Ranganathan R *et al.* 2005; Serra-Majem L *et al.* 2007].

Olive oil is the main component of the Mediterranean diet and this is the mostly consumed before those other oils such as sunflower, corn, soybeans, etc. [Trichopoulou A. 2004; Ayechu-Diaz A & Dura T. 2004; Tur JA *et al.* 2004] In the meat group, were individually evaluated: egg, chicken, fish, pork and others, the results showed that egg

consumption was the highest. But in assessing, chicken and fish as a white meat, these were the most consumed, followed by eggs, pork and others. In the group of other fat were the salad dressing, sausages and butter. According to the food guide pyramid guidelines, alcoholic beverage must be in a casual and moderate consumption. In our study, the beer is consumed mostly in the background and alcoholic beverages (gin, ron, whiskey, cognac, vodka, etc.) while table wine (red or white) is in third place in the consumer group.

The contribution to the intake of each food sample in the feeding behavior of the population Balearic population, despite some shortcomings in the recommendations for certain food groups is clear to observe the characteristics of a traditional mediterranean diet which is characterized by high fish intake, olive oil, fruits and vegetables, poultry, nuts, skim milk, cereals and table wine [Tur JA *et al.* 2004; Trichopoulou A *et al.* 2004; Serra-Majem L *et al.* 2007; Aranceta J. 2001] Others studies showed similar results. For example in the cereal group is the bread increased consumption, followed by pasta and fries. The fats group, butter and margarine are the most consumed, used to season bread and vegetables [Ribas-Barba L *et al.* 2007]. The soft drinks group, is the refreshments and other sugary drinks the most consumed. The fruit and vegetables showed that the number of serving is less than the recommendations. The higher or lower food intake in the different population groups is determined by different factors, social, cultural, economic and different lifestyles, [Nasreddine L *et al.* 2006; Sharma S *et al.* 2007]. The changes in eating patterns has led to population groups suffer from the increased prevalence of obesity and associated diseases, noting also lower levels of physical activity [Gillian S., *et al.* 2004].

This study demonstrates that there are certain gender differences in energy consumption, nutrients and foods. Women show greater compliance with the recommendations of FAT, MUFA's, PUFA's, cholesterol, fruits and vegetables, while men only show better compliance to the recommendation of carbohydrates and fiber. The compliance rate for total fat, protein and sodium showed no significant differences between genders, however, the percentages of compliance to the recommendations of men and women are similar to those of the general population. In a similar Survey in 1999 and 2000, women who also showed a better compliance in the cholesterol recommendations, carbohydrates, SFA, vegetables and total fat [Tur JA *et al.* 2004; Bondia-Pons I *et al.* 2007] This may be attributed to increased nutrition knowledge and concern about body weight and health status among the population female. In this study,

only men showed a greater compliance for micronutrients, fiber and PUFA and no significant difference MUFA and fruit. [Tur JA *et al.* 2004]. Other Studies assessing food intake, showed that men have a significantly higher intake of bread, cereal and cereal products, egg, meat, meat products, potatoes, legumes, nuts, sugar and derivatives, fat, oil, alcoholic beverage and soft drinks, both the nutrient and food intake [Nasreddine L *et al.* 2005; Hermann-Kunz E & Thamm M. 1999].

Studies show that selection in food intake between men and women, is associated with different factor or components of coherence and cognitive and emotional and instrumental, which show the greatest risk to endemic diseases [Lindmark *et al.* 2005], as in studies that have intake assessed, both men and women show a consumption of less than the recommendation of fruit, vegetables and dairy products, while meat rations shown above recommendation [Sharma S *et al.* 2008].

Our results show that more than half of adults in Balearic Island does not comply with recommendation with the WHO/FAO food dietary factor of total fat, carbohydrates, PUFA's, dietary fiber and sodium, while only half of the population meets the recommendations of cholesterol, fruits and vegetables. This should be emphasized to ensure the success of the WHO/FAO food dietary factors and common public health goals.

The dietary pattern of individuals in relation to both WHO/FAO recommendation and guidance of the USDA food in the category of quartiles of FAT and SFA, were similar, except for fruits and vegetables and sodium. Low intake of dietary fiber is accompanied by a low intake of fruit and vegetables, major sources of fiber are cereals, fruits and vegetables. The most important difference in the largest fiber intake is markedly higher intake of fruits and vegetables.

In other studies, showed that most population not meet the dietary guideline recommendations [Ghadirian P & Shatenstein B. 1996], most shows have a diet with less vegetables and whole grains, and relatively less than the recommendation fruit, milk and oils, and pervasive consumption of fat, added sugars and alcohol are considered sources of empty calories that contribute to obesity epidemic [Krebs-Smith SM *et al.* 2010]. Consumption data indicates that consumers must make significant changes in eating patterns to achieve the objectives of consumption in the main food group MyPiramide, and other nutrients of interest to adults, who are considerably low due to low intake fruit and vegetables [Hornick BA *et al.* 2008].

Other studies, showed that people with higher social class tend to have healthier diet and eating more fruit and vegetables. Although differences in nutrient intake are not clear, it was observed that groups have a better educated, have higher intake of fruit and vegetables, mainly in northern and Western Europe [Roos G *et al.* 2000].

Adherence to dietary guidelines and common objectives of public health in the adult population of Balearic is low, it is necessary a detailed analysis of current eating patterns to improve intervention strategies and improve adherence to these guidelines, allowing step by step approach the differences between eating habits and ideal diet, with the aim of improving nutritional intervention policies, retaining most of the characteristics of a healthy Mediterranean diet.

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References

1. Tur JA, Romaguera D, Pons A: Food Consumption Patterns in a Mediterranean Region: Does the Mediterranean Diet Still Exist? *Ann Nutr Metab* 2004; 48:193-201.
2. Song-Yi Park, Suzanne P. Murphy, Lynne R. Wilkens, Jennifer F. Yamamoto, Sangita Sharma, Jean H. Hankin, Brian E. Henderson, and Laurence N. Kolonel. Dietary Patterns Using the Food Guide Pyramid Groups Are Associated with Sociodemographic and Lifestyle Factors: The Multiethnic Cohort Study. *J Nutr.* 2005; 135:843-84
3. Sharma S, Cao X, Gittelsohn J, Ho LS, Ford E, Rosecrans A, Harris S, Hanley AJ, Zinman B; Dietary intake and development of a quantitative food-frequency questionnaire for a lifestyle intervention to reduce the risk of chronic diseases in Canadian First Nations in north-western Ontario: *Public Health Nutr.* 2008;11(8):831-40.
4. Boylan S, Welch A, Pikhart H, Malyutina S, Pajak A, Kubinova R, Bragina O, Simonova G, Stepaniak U, Gilis-Januszewska A, Milla L, Peasey A, Marmot M, Bobak M; Dietary habits in three Central and Eastern European countries: the HAPIEE study. *BMC Public Health.* 2009; 9: 439
5. W.D. Clay. Nutrition Programmes Service. Preparation and use of food-based dietary guidelines. *Food, Nutrition and Agriculture* 1997;19: 42–47
6. Serra-Majem L, Ribas-Barba L, Salvador G, Jover L, Raidó B, Ngo J, Plasencia A. Trends in energy and nutrient intake and risk of inadequate intakes in Catalonia, Spain (1992–2003). *Public Health Nutr.* 2007 (11A):1354-67.
7. Tur JA, Romaguera D & Pons A: Adherence to the Mediterranean dietary pattern among the population of the Balearic Islands. *Brit J Nutr* 2004; 92:341-346.
8. Serra Majem LI, Ribas Barba L, Salvador Castell G, Roman Viñas B, Castell Abat C, Cabezas Peña C, Pastor Ferrer MC, Raidó Quintana B, Ngo de la Cruz J, García Alvarez A, Serra Farró J, Salleras Sanmartí L, Taradach Antoni P. Trends in the nutritional status of the Spanish population: results from the

- Catalan nutrition monitoring system (1992-2003). Rev Esp Salud Pública. 2007; 81(5):559-70.
9. Ribas-Barba L, Serra-Majem L, Salvador G, Castell C, Cabezas C, Salleras L, Plasencia A. Trends in dietary habits and food consumption in Catalonia, Spain (1992-2003). Public Health Nutr. 2007; 10(11A):1340-53.
 10. Martin-Moreno JM, Boyle P, Gorgojo L, et al. Development and validation of a food frequency questionnaire in Spain. Int J Epidemiol. 1993; 22:512-519.
 11. Serra-Majem L, Morales D, Domingo C, Caubet E, Ribas L & Nogués RM: Comparison of two dietary methods: 24-hour recall and semiquantitative food frequency questionnaire (in Spanish). Med Clin (Barc) 1994; 103:652-656.
 12. Bondia-Pons I, Serra-Majem L, Castellote AI, López-Sabater MC: Identification of foods contributing to the dietary lipid profile of a Mediterranean population. Brit J Nutr. 2007; 98; 583-592.
 13. Moreiras O, Carvajal A, Cabrera L, Cuadrado C: *Tablas de composición de alimentos (Food Composition Tables)*, ed 7th. Madrid: Pirámide, 2003.
 14. Mataix J, Mañas M, Llopis J, Martínez de Victoria E, Juan J, Borregón A: *Tablas de composición de alimentos españoles (Spanish Food Composition Tables)*, ed 4th. Granada: INTA-Universidad de Granada, 2004.
 15. Feinberg M, Favier JC, Ireland-Ripert J : *Répertoire général des aliments (Food Composition Tables)*. París, Tec & Doc Lavoisier, 1995.
 16. Ripoll L : *Cocina de las Islas Baleares (The Balearic Islands Cookery)*, ed 5th. Palma de Mallorca, L. Ripoll Ed, 1992.
 17. Cleveland LE, Moshfegh AJ, Albertson AM, Goldman JD. Dietary intake of whole grains. J Am Coll Nutr. 2000;19:331S-338S
 18. Ranganathan R, Nicklas TA, Yang SJ, Berenson GS: The nutritional impact of dairy product consumption on dietary intakes of adults (1995-1996): the Bogalusa Hearth Study. J Am Diet Assoc 2005; 105(9):1391-400.
 19. Serra-Majem L, Ribas-Barba L, Salvador G, Serra J, Castell C, Cabezas C, Plasencia A. Compliance with dietary guidelines in the Catalan population: basis

- for a nutrition policy at the regional level (the PAAS strategy). *Public Health Nutr.* 2007;10(11A):1406-14.
20. Tripochoyopoulou A. Traditional mediterranean diet and longevity in the elderly: a review. *Public Health Nutr.* 2004;7(7):943-947
 21. Ayecheu-Diaz, A, Dura T: Mediterranean diet and adolescents. *Nutr Hosp* 2009;24: 759–760.
 22. Nasreddine L, Hwalla N, Sibai A, Hamzé M, Parent-Massin D: Food consumption patterns in an adult urban population in Beirut, Lebanon. *Public Health Nutr* 2006;9:194-203.
 23. Aranceta J. Spanish food patterns. *Public Health Nutr.* 2001;4(6A):1399-402.
 24. Gillian Swan: Finding from the latest national diet and nutrition Survey. *Proceeding of nutrition society*, 2004; 63:505-5012.
 25. Tur JA, Romaguera D & Pons A: Does the diet of the Balearic population, a Mediterranean-type diet, ensure compliance with nutritional objectives for the Spanish population? *Public Health Nutr.* 2004;8(3): 275-283
 26. Bondia-Pons I, Serra-Majem L, Castellote AI, López-Sabater MC. Compliance with the European and national nutritional objectives in a Mediterranean population. *Eur J Clin Nutr.* 2007 Dec;61(12):1345-51.
 27. Hermann-Kunz E and Thamm M (1999). Dietary recommendations and prevailing food and nutrient intakes in Germany. *Brit J Nutr.* 81: S61-S69
 28. Lindmark et al; Food selection associated with sense of coherence in adults, *Brit J Nutr* 2005;4:9
 29. Ghadirian P, Shatenstein B. Nutrient patterns, nutritional adequacy, and comparisons with nutrition recommendations among French-Canadian adults in Montreal. *J Am Coll Nutr.* 1996;15(3):255-63.
 30. Sharma S, Cao X, Gittelsohn J, Ho LS, Ford E, Rosecrans A, Harris S, Hanley AJ, Zinman B. Dietary intake and development of a quantitative food-frequency questionnaire for a lifestyle intervention to reduce the risk of chronic diseases in Canadian First Nations in north-western Ontario, *Public Health Nutr.* 2007;11(8):831-840

31. Krebs-Smith SM, Guenther PM, Subar AF, Kirkpatrick SI, Dodd KW. Americans do not meet federal dietary recommendations. *J Nutr* 2010;140(10): 1832-8
32. Hornick BA, Krester AJ, Nicklas TA. Menu modeling with My Pyramid food patterns: incremental dietary changes lead to dramatic improvements in diet quality of menus. *J Am Diet Assoc.* 2008;108(12):2077-83
33. Roos G, Johansson L, Kasmel A, Klumbiené J, Prättälä R. Disparities in vegetable and fruit consumption: European cases from the north to the south. *Public Health Nutr.* 2001; 4(1):35-43.

Table 1. Food sources of My Pyramid food groups listed in descending order by percentages of their contribution to intakes of adult population of Balearic Island, Spain.

Rank	Food item	Contribution to intake (%)
Cereals		
1	bread	48.3
2	pasta	22.4
3	rice	21.0
4	other cereals ¹	8.3
Vegetables		
1	raw vegetables	61.4
2	cooked vegetables	38.6
fruit		
1	fruit	75.8

2	natural juice	21.3
3	dried fruit ²	2.9
	Milk	
1	semi-skimmed milk	44.0
2	whole milk	33.0
3	skimmed milk	23.0
	Dairy products	
1	yoghurt	61.0
2	Cheese ³	26.8
3	flan	12.2
	meat	
1	eggs	34.0
2	chiken	21.0
3	fish	19.0
4	pig	16.0
5	Others ⁴	10.0
	Oils	
1	olive oil	90.5
2	other oils ⁵	9.5
	Other fats	
1	dressings	48.0
2	bacon	28.0
3	butter	24.0
	Sugar and cakes	
1	pastries	29.6
2	Other ⁶	19.9
3	sugar	18.5
4	chocolat	17.2
5	candy	14.8
	Soft drinks	
1	refreshment	35.7
2	comercial juice	24.0
3	coffee	19.1
4	tea	19.0
5	cerveza sin alcohol	2.2
	Alcoholic beverages	
1	beer	41.3
2	Alcoholic beverage ⁷	26.8
3	wine	24.9
4	Other ⁸	7.0

¹Includes cookies and breakfast cereal; ²Includes raisins, prune, drieds figs, etc. ³Includes varieties of cheese;

⁴Includes lamb and sausage; ⁵Includes sunflower, soybean, corn, etc. ⁶Includes marmalade, honey, cocoa;

⁷Includes gin, rum, whisky, cognac, vodka; ⁸Includes cava, coffee and alcoholic beverage.

Table 2 Proportion of compliers with the WHO/FAO food guide dietary factors in adult population of the Balearic Island, Spain.

Percentage of compliers with the WHO/FAO food guide dietary factors in men and women

WHO/FAO food guide Dietary Factor	Recommended ranges	All (n = 1388)	Men (n = 581)	Women (n = 807)
Total Fat (% energy)	15-30 %	18.3	21	16.5 ^{NS}
Total Carbohydrate (% energy)	55-75%	11.2	12.9	10
Protein (% energy)	10-15%	32.9	33.9	32.4 ^{NS}
SFA (% energy)	<10%	31.2	30.7	31.5
MUFAs (% energy)	15 -20%	38.5	38.3	38.6
PUFAs (% energy)	6-10%	11.8	9.5	13.5
Cholesterol (mg/d)	<300 mg/d	52.5	49.9	54.4
Fruit and vegetables	≥ 400g/d	52	48.5	58.8
Total dietary fiber (g/d)	>25 g/d	16.2	18.9	14.4
Sodium (g/day)	<2 g/d	0.2	0.4	0.1 ^{NS}

SFA = saturated fatty acids; MUFAs = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids.

^{NS} Differences between gender percentages are not statistically significant. All other differences are statistically significant (chi-square test; p < 0.05).

Table 3 Mean intake values for the WHO/FAO food guide dietary factors classified according to lowest and highest quartiles of common nutritional targets of public health in adult population of the Balearic Island, Spain.

WHO/FAO food guide Dietary Factor	Recommended ranges	Consumer, %	FAT		SFA		F & V		DIETARY FIBER	
			Low (<32.05%)	High (>43.2%)	Low (<9.30%)	High (>14.8%)	Low (<244.81g/d)	High (>654.3g/d)	Low (<11.65g/d)	High (>22.0g/d)
Total Fat (% energy)	15-30 %	18.3	27.02±4.2	48.89±4.7	31.36±7.7	44.85±7.2	38.30±8.3 ^{NS}	38.17±8.7 ^{NS}	40.13±9.7	35.81±7.7
Total Carbohydrate (% energy)	55-75%	11.2	53.15±7.2	33.94±6.5	48.44±9.5	38.28±9.0	43.84±9.4 ^{NS}	43.80±9.4 ^{NS}	40.88±10.4	46.86±8.1
Protein (% energy)	10-15%	32.9	17.86±5.3	16.68±4.3	18.33±5.8	16.37±4.4	16.73±4.7 ^{NS}	17.01±4.7 ^{NS}	17.72±5.0	16.31±4.6
SFA (% energy)	<10%	31.2	9.03±2.8	15.47±4.1	7.35±1.4	17.67±2.5	13.26±4.1	11.64±3.9	13.82±4.5	10.93±3.5
MUFAs (%energy)	15 -20%	38.5	11.20±3.0	22.78±4.0	15.10±5.4	18.83±4.7	16.94±4.8	17.40±5.5 ^{NS}	17.74±5.6	16.11±5.0
PUFAs (% energy)	6-10%	11.8	3.27±1.3	5.55±2.2	4.51±2.0	4.20±1.7	4.21±1.7	4.66±2.1	4.22±1.8	4.56±2.0
Cholesterol (mg/d)	<300 mg/d	52.5	277.78±243.4	392.62±210.0	273.99±250.5	398.59±222.0	365.66±234.3	324.54±199.3	346.63±214.8	323.37±202.2
Fruit and vegetables	≥ 400g/d	52	497.46±327.5	493.97±349.3	554.70±20.0	425.34±289.0	146.98±67.1	943.40±341.1	373.51±267.5	632.64±428.7
Total dietary fiber (g/d)	>25 g/d	16.2	19.31±9.7	15.32±7.7	20.06±9.2	14.32±6.4	14.80±7.0	20.61±8.7	8.82±2.1	28.83±7.0
Sodium (g/day)	<2 g/d	0.2	21.21±14.5 ^{NS}	20.35±11.4 ^{NS}	18.20±12.7	23.63±11.6	23.11±11.8	19.50±11.10	16.86±8.5	26.28±16.1

FAT = fat acids totals; SFA = saturated fatty acids; F & V = fruits and vegetables.

All variables are statistically significant between groups ($p < 0.05$) except those identified as NS (Non-Significant), Mean ± SD.

Values are adjusted for total reported energy intake, sex and age. A analysis of covariance was used to test the difference between quartile categories of nutritional targets.

Manuscript III

Changes in food consumption patterns in the adult population of the Balearic Island (1999 – 2010): A comparison with the nutritional objectives for the Spanish population.

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Running title: Food consumption patterns in the Balearic Islands

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Abstract:

Aims: Assessment changes in nutrient intake in the last ten years of the adult population of the Balearic Island, compared with the final nutrition objectives for the Spanish population.

Methods: Two consecutive cross-sectional studies conducted on random samples of the adult population of the Balearic Island, Spain. The present analysis is based on data from 2843 individuals aged 16 – 65 years, pooled from the two survey (867 men and 1976 women): 1455 belonged to ENIB 1999 – 2000 (286 men and 1169 women) and 1388 belonged to OBEX 2009 – 2010 (581 men and 807 women), dietary habits were assessed by means of a semi-quantitative food frequency questionnaire (FFQ), and two 24-hour recall on non-consecutive days. Spanish food consumption tables were used.

Results: The trends from 1999 to 2010 show an excess protein intake (ENIB $17.66 \pm 0.14\%$ and OBEX $17.50 \pm 0.15\%$), total fat (ENIB $38.75 \pm 0.23\%$ and OBEX $37.43 \pm 0.24\%$), SFA (ENIB $13.53 \pm 0.11\%$ and OBEX $11.93 \pm 0.11\%$), cholesterol (ENIB $362,22 \pm 5,47$ mg/d and OBEX $315,23 \pm 5,78$ mg/d), BMI (ENIB $24,52 \pm 0,12$ and OBEX $25,16 \pm 0,13$). Below the recommended values were observed in carbohydrate (ENIB $42.82 \pm 0,26\%$ and OBEX $44.06 \pm 0.27\%$), PUFA's (ENIB 4.68 ± 0.06 and OBEX 4.37 ± 0.06), fruits (ENIB $(162,76 \pm 5,77$ g day⁻¹ and OBEX $280,83 \pm 6,10$ g day⁻¹), Vegetables (ENIB 186.01 ± 4.57 g day⁻¹ and OBEX 175.71 ± 4.83 g day⁻¹), dietary fiber (ENIB $15,62 \pm 0,19$ g day⁻¹ and OBEX $17,24 \pm 0,20$ g day⁻¹). Also, lower were observed in folate intake, calcium and iodine. The Physical Activity Level (PAL) in the OBEX survey was 1.67. **Conclusions:** Mainly in young adults, should be promoted increased consumption of fruit, vegetables, dietary fibre and related nutrients as deficiency disease, iodine, folate and calcium. In addition to increasing the physical activity level in leisure time.

Introduction

Nutritional survey play an important role in epidemiological research and the development of food and nutrition policies. The results of the two nutrition surveys conducted in the adult population of the Balearic Islands (ENIB 1999-00 y OBEX 2009-10) have provided the necessary information on key health and nutrition problems in the Balearic Islands. In therefore is necessary to the analysis based on the grade of compliance with nutritional objectives for the Spanish population given by the Spanish Society of Community Nutrition (SENC) and its design is based on previous studies in Spain under a Mediterranean context [Serra- Majen L & Aranceta J. 2009].

The observed changes in food patterns have similarities with changes observed in developed countries, characterized by an increase in the consumption of foods of animal origin, the presence of large quantities of refined high-energy dense products, simultaneously accompanied by a low consumption of food of vegetable origin [Serra- Majem L *et al.* 2007; Trolle L & Lagiou P. 2007].

The prevalence of obesity is increasing in the United States and in many European countries, including Spain. Genetic background or susceptibility is one cause of obesity, but lifestyle factors such as physical activity and dietary factors may be more important in this alarm increase. These two factors might have a strong influence on health and are considered as fundamental risk factors for several chronic diseases, such as type 2 diabetes, cardiovascular diseases and obesity [Vioque J *et al.* 2008; Ottevaere C *et al.* 2011; Sheehy T & Sharma Sangita. 2011].

The purpose of this document was assessment changes in nutrient intake in the last ten years of the adult population of the Balearic Island, compared with the final nutrition objectives for the Spanish population and provide the information necessary to continue the development of prevention plans and improve their health status of the population.

Methods

Study design

The nutritional data from the present study are derived from the last two Balearic Island Nutritional Survey carried out in 1999 – 2000 (ENIB) and 2009 – 2010 (OBEX).

Sample

Samples were selected by considering the proportion of the number inhabitants and the specific weight of each municipality in the sample and the sample population was derived from residents aged 16-65 years registered in the official population census of the Balearic Island. The response rates in both surveys were of 97%. The present analysis is based on data from 2843 individuals aged 16 – 65 years, pooled from the two survey (867 men and 1976 women): 1455 belonged to ENIB 1999 – 2000 (286 men and 1169 women) and 1388 belonged to OBEX 2009 – 2010 (581 men and 807 women).

Questionnaires

For both surveys, dietary questionnaires and global questionnaire incorporating questions related to socio-economic status, education level and life-style factors were utilized. The dietary questionnaires included two 24-hours diet recalls and a semi-quantitative food frequency questionnaire (FFQ). FFQ was previously validated [Martin-Moreno JM *et al.*1993] and applied to other studies and surveys over the Spanish population [Tur JA *et al.* 2004; Tur JA *et al.* 2004; Serra-Majem L *et al.* 1994; Bondia-Pons I *et al.* 2007]. The FFQ, which asked the subject to recall average use over the past year, consisted of 145 items (118 of the original validated FFQ plus the most characteristic Balearic Islands foods in order to make easy the interviewee answer), and arranged by food type and meal pattern. Frequency of food consumption was based on times that food items were consumed (per day, week or month). Consumption <1/month was considered no consumption. Daily consumption (g) was determined by dividing the reported amount of the intake by the frequency (d). The period of consumption of seasonal items was also considered. Edible fractions of foods were recorded in the database [Martin-Moreno JM *et al.*1993; Serra-Majem L *et al.* 1994; Bondia-Pons I *et al.* 2007].

The questionnaires were administered in the subject's home, area work, health centre or other public site. To avoid bias brought on by day-to-day intake variability, the questionnaires were administered homogeneously from Monday to Sunday. In order to estimated volumes and portion sizes, the household measures found in the subject's own homes were used. Conversion of food into nutrients was made using a self-made computerized program based on Spanish [Moreiras O *et al.* 2003; Mataix J *et al.* 2004] and European [Feinberg M *et al.*1995]. Food Composition Tables and complemented with food composition data available for Majorcan food items [Ripoll L. 1992].

The physical activity level (PAL) was calculated according to the categorization of physical activity undertaken by respondents (repose, very light, light, moderate and severe), subsequently added the corresponding factor according to the category of activity. The survey included questions on time spent on the activities carried out within 24 hours, intensity and frequency of activities [Ortega RM *et al.* 2004].

Statistics

Analyses were performed with SPSS version 17.0. Feeding patterns and nutrient intake and compliance with final nutrition objectives for the Spanish population 2010, consensus from the Spanish society of Community Nutrition, were compared by ANCOVA and adjusted by energy intake, sex and age. Level of significance for acceptance was P value < 0,05.

Ethics

The present study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects were approved by the Balearic Islands Ethics Committee. Written informed consent was obtained from all subjects and their parents or legal tutors

Results

Table 1 shows the sample distributions of both surveys by gender and age group, which were similar to one another as well as being representative of the Balearic Island population in the years when the survey were carried out (1999 – 2000 and 2009 – 2010). The mean age of the subjects was 37 years in ENIB 1999-2000 and 31 years in OBEX 2009 – 2010.

Table 2 shows the comparison of the characteristics of the diet between ENIB 1999—00 and OBEX 2009-10 in the adult population of the Balearic Island with nutritional objectives for the Spanish population. The protein percentage was slightly higher than the recommendation and no significant changes were observed in both studies. Carbohydrate intake showed values below the recommendations. However the survey OBEX shows a significant increase. (ENIB $42.82 \pm 0,26$ % and OBEX $44.06 \pm 0.27\%$). Total fat percentage was higher in both studies, showing a slight decrease in OBEX (ENIB 38.75 ± 0.23 % and OBEX $37.43 \pm 0.24\%$). The behavior was similar to SFA

(ENIB 13.53 ± 0.11 % and OBEX 11.93 ± 0.11 %). In relation to the intake of fruits was observed a significant increase in OBEX (ENIB 166.41 ± 5.91 g day⁻¹ and OBEX 276.82 ± 5.91 g day⁻¹) but both values were below the recommendation. In OBEX vegetable intake was lower (ENIB 193.25 ± 5.03 g day⁻¹ and OBEX 168.17 ± 4.07 g day⁻¹), both values were below the recommendation. Dietary fiber showed a significant increase in OBEX (ENIB 15.62 ± 0.19 g day⁻¹ and OBEX 17.24 ± 0.20 g day⁻¹) without reaching the recommendation in both studies.

Table 3 show comparison of food patterns between ENIB (1999-2000) and OBEX (2009-2010) of Balearic Island population whit the final nutrition objectives 2010. The table compares mean daily energy and nutrient consummption in both studies, in total of the adult population of Balearic Island, tha difference between the two surveys (ENIB 1999 – 2000 and OBEX 2009 – 2010) and statistical significance are also presented. The percentage of energy to carbohidrate intake showed slightly increase ENIB ($42,82 \pm 0,26\%$) and OBEX ($44,06 \pm 0,27\%$), but slightly below to recommendations, however, the intake fat showed increase in both studies, mantained the values between ENIB ($38,75 \pm 0,23$ %) and OBEX ($37,43 \pm 0,24\%$). SFA intake was most in the two studies in relationship to recomendation (7 – 8 %), ENIB ($13,53 \pm 0,11\%$) and OBEX ($11,93 \pm 0,11\%$). Whit respect to MUFA was mantained in levels of recomendations in both studies, while PUFA's show values slightly lower than the recomendations in both studies (ENIB 4.68 ± 0.06 and OBEX 4.37 ± 0.06). Was observed cholesterol intake increased in both studies ENIB ($362,22 \pm 5,47$ mg/d) and OBEX ($315,23 \pm 5,78$ mg/d) versus recomendations < 300 mg/day.

With respect to fruit intake was observed a significance increased in OBEX ($280,83 \pm 6,10$) versus ENIB ($162,76 \pm 5,77$) however, the fruit intake is lower to recomendation in both studies. The results from vegetables intake not showed changed significative in two studies, however, is observed a trends to decreased in the OBEX survey. Fibre intake showed a increased intake in OBEX ($17,24 \pm 0,20$ g/d) while in ENIB was ($15,62 \pm 0,19$ g/d) the average fibre intake recomendad is >25 g/d.

With respect other nutrients, folate intake increased in OBEX ($303,93 \pm 4,40$ µg/d) while in ENIB was ($272,76 \pm 4,17$ µg/d) the average folate intake recomendad is >400 µg/d. Calcium intake are within the recomendation in both studies, ENIB ($836,84 \pm 17,01$ mg/d) only observed a slightly decreased in OBEX ($776,26 \pm 17,98$ mg/d), when the recomendation is ≥ 800 mg/d. Sodium intake is similar in both studies with intake

average of 2 g/d. this value are within the recommendation (< 6 g/d). iodine showed intake in ENIB ($86,10 \pm 1,39$ $\mu\text{g/d}$) and OBEX ($122,68 \pm 1,47$ $\mu\text{g/d}$), this value was lower to the recommendation (150 $\mu\text{g/d}$).

With respect the body mass index in both studies was observed that the average values was higher the recommendation (21 – 23), ENIB showed (BMI of $24,52 \pm 0,12$), while in OBEX was observed an increase of BMI ($25,16 \pm 0,13$) ($P < 0,05$)

The physical activity levels were only assessed in OBEX showing a slightly lower value (PAL = 1,67) compared to average level of physical activity recommended (PAL $> 1,75$).

The alcoholic beverage showed intake low in ENIB (98,67 ml/d) and OBEX ($46,16 \pm 3,14$ ml/d), the recommendation of wine is < 2 glasses/d, however, moderate wine consumption is considered permissible if limited to 250 – 400 ml/d.

Table 4 shows the comparison of food patterns between ENIB (1999 – 2000) and OBEX (2009 – 2010) with the final nutrition objectives 2010 for age and sex group of adult population of Balearic Island.

Table 4 (a y b) shows the evolution of food consumption patterns by age and gender of the adult population of the Balearic Islands. The positive or negative variations in food patterns consumption were especially observed between the age range of the 16 to 45 years. In this sense, the average total carbohydrates showed a slightly increase mainly in men aged 16 to 25 years (ENIB 42.12 ± 0.74 and OBEX $46.02 \pm 0.53\%$). Regarding the percentage of total fat intake, men aged 16 to 25 years showed a slight decrease in intake (ENIB $39.82 \pm 0.67\%$ and OBEX $36.38 \pm 0.49\%$), while in women the decrease was observed in the age group 16 to 25 years (ENIB $39.41 \pm 0.47\%$ and OBEX $37.65 \pm 0.51\%$) and 26 to 45 years (ENIB $39.69 \pm 0.37\%$ and OBEX $38.42 \pm 0.45\%$). In relation to the intake of SFA, only men showed a slight decrease in the age group 16 to 25 years (ENIB $13.79 \pm 0.31\%$ and OBEX $12.56 \pm 0.23\%$) and 26 to 45 years (ENIB $13.04 \pm 0.32\%$ and OBEX $11.82 \pm 0.28\%$), while women showed a decrease of intake in all age groups analyzed. Respect the intake of MUFA, men aged 16 to 25 years showed a slight decrease in intake (ENIB $17.44 \pm 0.40\%$ and OBEX $16.15 \pm 0.29\%$), while women trend intake was higher in the age group 46 to 65 years (ENIB $16.18 \pm 0.24\%$ and OBEX $17.06 \pm 0.41\%$). PUFA intake was lower in the age group 16 to 25 years, in men (ENIB $5,01 \pm 0.15\%$ and OBEX $3.88 \pm 0.11\%$) and women (ENIB $4.59 \pm 0.11\%$ and OBEX $4.18 \pm 0.11\%$).

Respect to cholesterol intake, the men showed a significant decrease in the age group 16 to 25 years (ENIB $448.95 \pm 21.60 \text{ mg day}^{-1}$ and OBEX $376.29 \pm 15.61 \text{ mg day}^{-1}$) and 26 to 45 years (ENIB $433.56 \pm 15.64 \text{ mg day}^{-1}$ and OBEX $336.95 \pm 13.45 \text{ mg day}^{-1}$), while women showed a significant decrease in the age group 26 to 45 years (ENIB $347.96 \pm 7.80 \text{ mg day}^{-1}$ and OBEX $305.99 \pm 9.60 \text{ mg day}^{-1}$) and 46 to 65 years (ENIB $306.19 \pm 7.88 \text{ mg day}^{-1}$ and OBEX $261.68 \pm 13.18 \text{ mg day}^{-1}$).

Fruit intake was lower than recommended in both studies, however, a significant increase was observed in all age groups tested in both sexes.

In relation to vegetables intake, was observed a decrease of intake in men the age groups 16 to 25 years (ENIB $135.31 \pm 13.05 \text{ g day}^{-1}$ and OBEX $114.82 \pm 8.24 \text{ g day}^{-1}$) and 46 to 65 years (ENIB $215.67 \pm 19.45 \text{ g day}^{-1}$ and OBEX $162.98 \pm 16.82 \text{ g day}^{-1}$), while in women the values were stable. Dietary fiber intake showed an increase in men of age group 16 to 25 years (ENIB $15.98 \pm 0.50 \text{ g day}^{-1}$ and OBEX $16.14 \pm 0.36 \text{ g day}^{-1}$) and 26 to 45 years (ENIB $16.57 \pm 0.68 \text{ g day}^{-1}$ and OBEX $19.80 \pm 0.59 \text{ g day}^{-1}$), while women only showed a significant increase in the age group 46 to 65 years (ENIB $13.92 \pm 0.36 \text{ g day}^{-1}$ and OBEX $17.58 \pm 0.58 \text{ g day}^{-1}$).

The group of women from 26 to 45 years showed an increase in folate intake (ENIB $263.39 \pm 6.49 \text{ mg day}^{-1}$ and OBEX $297.15 \pm 7.99 \text{ mg day}^{-1}$) and a decrease in calcium intake (ENIB $812.46 \pm 14.15 \text{ mg day}^{-1}$ and OBEX $766.96 \pm 17.42 \text{ mg day}^{-1}$). In relation to iodine intake, men and women showed a significant increase in all age groups tested without exceeding the recommendation.

BMI values in both studies were higher than those recognized as normal (21 – 23), the prevalence of overweight in men showed no significant changes in all age group, while in women was observed a significant increase in the age groups 16 to 25 years (ENIB 21.92 ± 0.38 and OBEX 23.25 ± 0.25) and 26 to 45 years (ENIB 24.20 ± 0.38 and OBEX 24.26 ± 0.26).

The physical activity level (PAL) was only assessed in the OBEX survey, men and women showed significant differences in all age groups with increased physical activity from age 26 years. Alcohol intake was low in OBEX survey, the most significant decline was observed in men 16 to 25 years (ENIB $123.38 \pm 12.89 \text{ ml}$ and OBEX $55.17 \pm 8.10 \text{ ml}$), while women showed a significant decreased in alcohol intake in all age group analyzed.

Discussion

The results of this analysis based on data provided by the last two Balearic Island survey (ENIB 1999-2000 and OBEX 2009-2010) show slight alterations in the intake of energy and nutrients in relations to final nutrition objectives 2010. Both studies comprise the Nutritional Surveillance System of the Balearic Island population. They were realised applying similar methodologies on representative samples of the population, and as such, provide valid comparison between the two studies. Nutrition objectives and food guides are evidence based and generally established by consensus by International Institutions or Scientific Societies. In Spain the nutrition objectives and, as a consequence, the food guides were developed by the SENC and have been widely distributed and published [Serra-Majem L & Aranceta J. 2009].

This is why it is important to emphasis that the data from ENIB 1999 – 2000 have been recoded and re-analysed according to the parameters used in OBEX 2009 – 2010. This has allowed the adjustment of variables for energy intake, sex and age thus making them totally suitable for comparison.

In the last ten years, changes in the habit of food and nutrient intake of the adult population of the Balearic Island are evident and consistent with the changes that have happened in most of the world, in some cases appear to be oriented to a healthier eating pattern, while in others there is a clear preference for unhealthy foods [Varela Moreiras G., et al. 2010; Fulgoni V *et al.* 2007]. However, while we can say that dietary habits and energy and nutrients intake of the adult population of the Balearic Islands conserved characteristics common to a Mediterranean diet, but with significant changes according to age group [Serra-Majem L. 2007].

Percentage of energy from protein was higher in both studies, the values remain stable and this may be a preference in the consumption of red meat and other products (sausages / meats), plus other source of protein [Serra-Majem L. 2007].

The percentage of energy from carbohydrate in the diet was below the recommendation in both studies, however, in the OBEX survey was observed a significant increase below the recommendation, mainly in men aged group 16 to 25 years. Total fat intake in the diet was higher than the recommendation in both studies, however, in the last ten years was a slight decrease without reaching the recommended percentage. Men and woman show a tendency to decrease fat intake, this decrease was clearly observed in young men age group 16 to 25 years and women in the age range 16 to 45 years. Oils and

fats, and products made thereof, play an important role in diets worldwide. The nutritional characteristics of these products vary widely: whereas some are low in bad fats and high in good fats, others are not. Though good data on the intake of dietary fats are not available for large parts of the world, it is evident that despite healthier alternatives, a significant proportion of the fat consumed is too high in SFA and low in essential fats (omega-3 and -6 PUFA) [Zevenbergen H., et al. 2009]. In addition, it has been proposed that fat intake is less well regulated than carbohydrate intake and that high-fat diet lead to obesity in populations independently of total energy intake [Seidell JC. 1998].

Of the total fats, SFA showed higher values than the recommendation in both studies, the survey OBEX men in the age group 16 to 25 years showed a slight decrease, while women were significantly decreased in all age groups analyzed. Situation in the cas of MUFA, in OBEX survey the group of men from 16 to 25 years and women 46 to 65 years showed a significant decline in intake. The intake of PUFA showed values slightly lower than the recommendation in both studies, in OBEX survey this decrease was mainly observed in men and women aged 16 to 25 years [Razanamahefa L *et al.* 2005].

Cholesterol intake was higher than the recommendation in both studies, the survey OBEX showed a intake decrease mainly in younger men age 16 to 45 years, while in women the decrease was observed in the age range of 26 to 65 years, however, these age groups are showing an increased intake of cholesterol probably due to the high intake of saturated fat, such as meat, dressings, sausage and egg, foods that provide the largest share of food group intake [Lourde Ribas L *et al.* 2007].

Low fruit intake is clear in both studies, however, OBEX survey showed a significant increase in men and women of all age group, this increase was below the recommended intake of fruit. The OBEX survey showed a decrease in the consumption of vegetables, mainly in men in the age group 16 to 25 years and 46 to 65 years, the handling at the intake of fruit and vegetables has also been observed in other studies [Aranceta J. 2005]. It is clear that the nutrients in fruits and vegetables, probably particularly the antioxidant micronutrients, are associated with real and substantial disease protection. And it is clear that the population's intake of these foods is remote from the recommended levels. It is likely that substantial public health benefits and disease reduction could be

achieved if consumption of fruits and vegetables were greatly increased over the low levels seen in United States and other industrialized nations. [Block G. 1991; Vioque J *et al.* 2008].

Dietary fiber is one of the nutritional components of plant food, a decreased intake of dietary fiber in Western countries is associated with an increased prevalence of chronic disease, epidemiological data suggest an inverse association between dietary fiber intake and disease chronic and a positive association with a healthy profile (lower blood pressure, reduces cholesterol level and insulin sensitivity) [Lin Y *et al.* 2011; Wolever JM & Jenkins DJ. 1977; Bazzano LA *et al.* 2003]. In the OBEX survey, dietary fiber intake showed a significant increase mainly in the age rang of 16 to 45 years in both sexes, this increase but lower than the recommendation may be related to the observed increase in fruit intake.

Regarding folate OBEX survey showed an increase in intake with values below the recommendation, this decrease may be related to low intake of fruit and vegetables mainly. In our study, women in the age rang from 16 to 45 years showed a significant increase in folate intake, while men showed an increasing trend with no significant variations between groups [Serra-Majem L *et al.* 2007]. In the cas of Calcium OBEX survey showed a slight decrease to values below the recommendation [Fulgoni V *et al.* 2004], this change is reflected in women prince of the age group of 26 to 45 years [Serra-Majem L *et al.* 2007]. Iodine intake in the OBEX survey showed a significant increase in men and women of all age group, without showing values higher than the recommendation.

The prevalence of obesity continues to increase in Spain, affecting more than 13% of the adult population which is major public health problem [Serra- Majen L & Aranceta J. 2009]. According to the BMI overweight prevalence showed an increase in the survey OBEX, the trend of overweight in men was higher without showing significant differences between groups, while in women the age range of 16 to 45 years showed a significant increase BMI. The average body mass index in the Spanish adult population is estimated to be 25.5 kg m^{-2} , which has been traslated into an intermediate objective of less than 25.5 kg m^{-2} . This corresponds with the 40th percentie [Serra- Majen L & Aranceta J. 2009].

In relation to physical activity level only present values obtained in the OBEX survey, the PAL value was 1.67 and only 14.3% of the population showed a PAL >1.75 (data not shown), men showed a higher physical activity level than women. In general it was observed that the level of physical activity increases with age, this may be linked to the level of physical activity performed according to the type of work and the number of hours of working time, studies have shown that sedentary lifestyle increases the risk of developing many health conditions particularly cardiovascular disease, hypertension, type 2 diabetes mellitus, colon and breast cancers, osteoporosis depression and backaches. Although many observational and experimental studies have demonstrated the benefit of increased physical activity in reducing chronic diseases in the general adult population [Guallar CP *et al.* 2004; Warwick PM. 2003; Trolle- Lagerros Y & Lagiou P. 2007; Bize R *et al.* 2007].

Conclusions

To comply with the final nutrition objectives for the adult population Spanish, it is necessary that the adult population make major changes in the habit of food consumption and decrease the percentage of energy provided by protein, total fat, SFA mainly. Increase fruit intake, vegetables, dietary fiber and related nutrient deficiency diseases such as folate, iodine and calcium as well as to increase physical activity during leisure time, these changes should be primarily recommended in young adults with the aim of reducing rates of overweight, obesity and associated disease in most adult age.

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References

1. Serra-Majem L and Aranceta J. Nutritional objectives for the Spanish population. Consensus from the Spanish Society of Community Nutrition. *Public Health Nutrition*. 2009; 4:1409-1413.
2. Serra-Majem L, Ribas Barba L, Salvador G, Serra J, Castell C, Cabezas C, Aranceta J. Compliance with dietary guidelines in the Catalan population: Basis for a nutrition policy at the regional level (the PAAS strategy). *Public Health Nutr*. 2007; 10:1406-1414.
3. Trolle Lagerros Y, Ligiou P. Assessment of physical activity and energy expenditure in epidemiological research of chronic diseases. *Eur J Epidemiol* 2007;22:353-362.
4. Vioque J, Weinbrenner T, Castelló A, Asensio L, García de la Hera M. Intake of fruits and vegetables in relation to 10-year weight gain among Spanish adults. *Obesity* 2008; 16:664-670.
5. Ottevaere C, Huybrechts I, Béghin L, Cuenca-García M, De Bourdeaudhuij I, Gottrand F, Hagströmer M, Kafatos A, Le Donne C, Moreno LA, Sjöström M, Widhalm K, De Henauw S. Relationship between self-reported dietary intake

- and physical activity levels among adolescents: the HELENA study. *Int J Behav Nutr Phys Act.* 2011; 8:8.
6. Sheehy Tand Sharma Sangita. The nutrition transition in the Republic of Ireland: trends in energy and nutrient supply from 1961 to 2007 using Food and Agriculture Organization food balance sheets. *Brit J Nutr.* 2011.
 7. Martin-Moreno JM, Boyle P, Gorgojo L, et al. Development and validation of food frequency questionnaire in Spain. *Int J Epidemiol.* 1993;22:512-519.
 8. Tur JA, romaguera D, Pons A: Food Consumption Patterns in a Mediterranean Region: Does the Mediterranean Diet Still Exist? *Ann Nutr Metab.* 2004;48: 193-201.
 9. Tur JA, romaguera D & Pons A: Adherence to the Mediterranean dietary patterns among the population of the Balearic Island. *Brit J Nutr.* 2004;92:341-346.
 10. Serra-Majem L, Morales D, Domingo C, Caubet E, Ribas L & Nogués RM: Comparison of two dietary methods: 24-hour recall and semiquantitative food frequency questionnaire (in Spanish). *Med Clin (Barc)* 1994; 103:652-656.
 11. Bondia –Pons I, Serra-Majem L, Castellote AI, López-Sabater MC: Identification of foods contributing to the dietary lipid profile of a Mediterranean population. *Brit J Nutr.* 2007; 98:583-592.
 12. Moreiras O, Carvajal A, Cabrera L, Cuadrado C: *Tablas de composición de alimentos (Food composition Tables)*, ed 7th Madrid: Pirámide, 2003.
 13. Mataix J, Mañas M, Llopis J, Martínez de Victoria E, Juan J, Borregón A: *Tablas de composición de alimentos españoles (spanish food Composition tables)*, ed 4th Granada: INTA-Universidad de Granada, 2004.
 14. Feinberg M, Favier JC, Ireland-Ripert J: *Répertoire général des aliments (Food Composition Tables)*. París, Tec & Doc Lavoisier, 1995.
 15. Ripoll L: *Cocina de la Islas Baleares (The Balearic Islands Cookery)*, ed 5th Palma de Mallorca, L. Ripoll Ed, 1992.
 16. Lin Y, Huybrechts I, Vandevijvere S, Bolca S, De Keyzer W, De Vriese S, Polet A, De Neve M, Van Oyen H, Van Camp J, De Backer G, De Henauw S: Fibre intake among the Belgian population by sex-age and sex- education groups and its association with BMI and waist circumference. *Brit J Nutr.* 2011.
 17. Wolever TM, Jenkins DJ. What is a high fiber diet? *Adv Exp. Med. Biol.* 1977; 427: 35-42.
 18. Bazzano LA, He J, Ogden LG, Loria CM, Whelton PK; Dietary fiber intake and reduced risk of coronary heart disease in US men and women: The National Health and Nutrition Examination Survey I epidemiologic Follow-up study. *Arch. Intern Med.* 2003; 163: 1897-904.

19. Serra-Majem L, Ribas Barba L, Salvador G, Jover L, Raidó B, Ngo J, Plasencia A; Trends in energy and nutrient intake and risk of inadequate intake in Catalonia, Spain (1992 – 2003). *Public Health Nutr.* 2007; 10: 1354-1367.
20. Guallar CP, Santa Olalla PP, Ramon BJ, Lopez E, Rodriguez AF; Physical activity and quality of life in older adults in Spain. *Med Clin (Barc)* 2004; 123:606-10.
21. Ortega RM, López AM, Andrés P. La composición de los alimentos. Herramientas básicas para la valoración nutricional. Madrid: Ed. Complutense, 2004.
22. Aranceta J. Fruits and Vegetables. *Arch. Latinoam Nutr.* 2004; 54: 65-71.
23. Warwik PM. Trends in energy and macronutrient intake, body weight, level of physical activity, and energy expenditure in relation to dietary intake in female students. 1988 to 2003. *J Clin Nutr.* 2003; 12:S56.
24. Razanamahefa L, Lafay L, Oseredezuk M, Thiébaud A, Laloux L, Gerber M, Astorg P, Berta JL. Dietary fat consumption of the French population and quality of the data on the composition of the major food groups. *Bull cancer* 2005; 92: 647-57.
25. Varela Moreiras G, Avila JM, Cuadrado C, Del Pozo S, Ruiz E, Moreiras O. Evaluation of food consumption and dietary patterns in Spain by the Food Consumption Survey. Updated information. *Eur J Clin Nutr* 2010; 3: 37-43.
26. Fulgoni V, Jill N, Reed A, Buckley R, Kafer K, Huth P, DiRienzo D, Miller GD. Dairy consumption and related nutrient intake in African-American adults and children in the intakes by individuals 1994-1996, 1998 and the National Health and Nutrition Examination Survey 1999-2000. *J Am Diet.* 2007; 107: 256-264.
27. Fulgoni V, Jill N, Reed A, Buckley R, Kafer K, Huth P, DiRienzo D, Miller GD. Determination of optimal number of dairy servings to ensure a low prevalence of inadequate calcium intake in Americans. *J Am Nutr.* 2004; 23: 651-659.
28. Block G. Dietary guidelines and the results of food consumption surveys. *Am J Clin Nutr.* 1991; 53:356S-7S.
29. Vioque J, Weinbrenner T, Castelló A, Asensio L, García de la Hera M. Intake of fruits and vegetables in relation to 10-year weight gain among Spanish adults. *Obesity* 2008; 16: 664-670.
30. Bize R, Johnson JA, Plotnikoff RC. Physical activity level and health-related quality of life in the general adult population: A systematic review. *Prev. Med.* 2007; 45: 401-15.

31. Zevenbergen H, de Bree A, Zeelenberg M, Laitinen K, van Duijn G, Floter E. Food with a high fat quality are essential for healthy diets. *Ann Nutr Metab.* 2009; 54: 15-24.
32. Seidell JC. Dietary fat and obesity: an epidemiologic perspective. *Am J Clin Nutr.* 1998; 67: 546S-550S.
33. Ribas-Barba L, Serra-Majem L, Salvador G, Castell C, Cabezas C, Salleras L, Plasencia A. Trends in dietary habits and food consumption in Catalonia, Spain (1992- 2003). *Public Health Nutr.* 2007; 10:1340-53.

Table 1 Sample distribution by sex and age group in both survey.

Sex	Age group (years)	ENIB (1999 – 2000)		OBEX (2009 – 2010)	
		n	%	n	%
Men	16 – 25	126	44	306	52.7
	26 – 45	103	36	201	34.6
	46 – 65	57	20	74	12.7
	Total	286	100	581	100
Women	16 – 25	307	26.3	293	36.3
	26 – 45	480	41	360	44.6
	46 – 65	382	32.7	154	19.1
	Total	1169	100	807	100
Total	16 – 25	433	29.8	599	43.2
	26 – 45	583	40	561	40.4
	46 – 65	439	30.2	228	16.4
	Total	1455	100	1388	100

ENIB (Nutrition survey of the Balearic Islands 1999 – 2000).

OBEX (Nutrition survey: Obesity and oxidative stress 2009 – 2010).

Table 2 Comparison of dietary characteristics between ENIB (1999-2000) and OBEX (2009-2010) of Balearic Island population whit the final nutrition objectives 2010.

Dietary characteristics	ENIB ¹ (Mean ± SEM)	Final nutrition objectives ²	OBEX ³ (Mean ± SEM)
% of Energy from proteins	17,66 ± 0,14	? 15 %	17,50 ± 0,15 ^{NS}
% of Energy from carbohydrates	42,82 ± 0,26	50 – 55%	44,06 ± 0,27
% of Energy from total fat	38,75 ± 0,23	30 – 35%	37,43 ± 0,24
% of Energy from SFA	13,53 ± 0,11	7 – 8%	11,93 ± 0,11
Fruit	166,41 ± 5,99	> 400 g day ⁻¹	276,82 ± 5,91
Vegetables	193,25 ± 5,03	> 300 g day ⁻¹	168,17 ± 4,07
Dietary Fiber (g/d)	15,62 ± 0,19	> 25 g day ⁻¹	17,24 ± 0,20

¹ENIB (Nutrition survey of the Balearic Islands 1999 – 2000)

²Consensus of the Spanish Society of Community Nutrition 2010.

³OBEX (Nutrition survey: Obesity and oxidative stres 2009 – 2010).

SFA = Saturated fat acids.

All variables are statistically significant between groups ($p < 0,05$) except those identified as NS (Non-Significant), and were compared by ANCOVA and adjusted by energy intake, sex and age.

Table 3 Comparison of food patterns between ENIB (1999-2000) and OBEX (2009-2010) of Balearic Island population with the final nutrition objectives 2010.

	ENIB ¹ (Mean ± SEM)	Final nutrition objectives 2010 ²	OBEX ³ (Mean ± SEM)
Total carbohydrates	42,82 ± 0,26	50 – 55%	44,06 ± 0,27
Total fat	38,75 ± 0,23	30 – 35 %	37,43 ± 0,24
SFA	13,53 ± 0,11	7 – 8 %	11,93 ± 0,11
MUFA	16,72 ± 0,13	15 – 20 %	16,81 ± 0,14 ^{NS}
PUFA	4,68 ± 0,06	5%	4,37 ± 0,06
Cholesterol	362,22 ± 5,47	< 300 mg day ⁻¹	315,23 ± 5,78
Fruit	162,76 ± 5,77	> 400 g day ⁻¹	280,83 ± 6,10
Vegetables	186,01 ± 4,57	> 300 g day ⁻¹	175,71 ± 4,83 ^{NS}
Dietary fiber	15,62 ± 0,19	> 25 g day ⁻¹	17,24 ± 0,20
Folate	272,76 ± 4,17	>400 µg day ⁻¹	303,93 ± 4,40
Calcium	836,84 ± 17,01	? 800 mg day ⁻¹	776,26 ± 17,98
Sodium	1,90 ± 0,03	< 6 g day ⁻¹	2,07 ± 0,03
Iodine	86,10 ± 1,39	150 µg day ⁻¹	122,68 ± 1,47
BMI ⁴	24,52 ± 0,12	21 - 23	25,16 ± 0,13
Physical activity ⁵		PAL >1.75	1,67
Alcohol (wine) ml ⁶	98,67 ± 2,98	< glasses day ⁻¹	46,16 ± 3,14

¹ENIB (Nutrition survey of the Balearic Islands 1999 – 2000)

² Consensus of the Spanish Society of Community Nutrition 2010.

³OBEX (Nutrition survey: Obesity and oxidative stress 2009 – 2010).

⁴ BMI – body mass index, (BMI, weight in kg/height² in meters), the average body mass index in the Spanish adult population is estimated to be 25.5 kg m⁻², which has been translated into an intermediate objective of less than 25.5 kg m⁻².

⁵Physical Activity: Physical activity Level (SENC)

⁶ moderate wine consumption is considered permissible if limited to 250 – 400 ml day⁻¹.

SFA – saturated fatty acids; MUFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids.

All variables are statistically significant between groups (p < 0,05) except those identified as NS (Non-Significant), and were compared by ANCOVA and adjusted by energy intake, sex and age

Table 4a Comparison of food patterns with the final nutrition objectives 2010, in men for age group in both studies.

	ENIB (1999 – 2000)			OBEX (2009 – 2010)		
	Age group years			Age group years		
	16 – 25 n = 126 (Mean ± SEM)	26 – 45 n = 103 (Mean ± SEM)	46 – 65 n = 57 (Mean ± SEM)	16 – 25 n = 306 (Mean ± SEM)	26 – 45 n = 201 (Mean ± SEM)	46 – 65 n = 74 (Mean ± SEM)
men						
Total carbohydrates	42,21 ± 0,74	42,18 ± 0,77	41,16 ± 1,15	46,02 ± 0,53	43,95 ± 0,66 ^{NS}	41,32 ± 1,26 ^{NS}
Total fat	39,82 ± 0,67	37,42 ± 0,69	37,96 ± 1,00	36,38 ± 0,49	36,78 ± 0,59 ^{NS}	38,19 ± 1,10 ^{NS}
SFA	13,79 ± 0,31	13,04 ± 0,32	12,37 ± 0,42	12,56 ± 0,23	11,82 ± 0,28	11,25 ± 0,46 ^{NS}
MUFA	17,44 ± 0,40	16,10 ± 0,40	16,57 ± 0,58	16,15 ± 0,29	16,41 ± 0,34 ^{NS}	17,66 ± 0,63 ^{NS}
PUFA	5,01 ± 0,15	4,40 ± 0,17	5,22 ± 0,30	3,88 ± 0,11	4,41 ± 0,14 ^{NS}	9,95 ± 0,33 ^{NS}
Cholesterol	4,48,95 ± 21,60	433,56 ± 15,64	372,60 ± 22,21	376,29 ± 15,61	336,95 ± 13,45	371,50 ± 24,16 ^{NS}
Fruit	157,29 ± 18,44	132,38 ± 20,77	156,80 ± 29,70	230,00 ± 11,64	276,04 ± 14,65	323,75 ± 25,70
Vegetables	135,31 ± 13,05	159,08 ± 15,31	215,67 ± 19,45	114,82 ± 8,24	141,66 ± 10,80 ^{NS}	162,98 ± 16,82
Dietary fiber	15,98 ± 0,50	16,57 ± 0,68	18,40 ± 0,88	16,14 ± 0,36	19,80 ± 0,59	14,49 ± 0,95 ^{NS}
Folate	258,10 ± 11,10	308,33 ± 14,07	328,41 ± 17,80	273,48 ± 8,64 ^{NS}	336,42 ± 12,11 ^{NS}	340,66 ± 19,36 ^{NS}
Calcium	1074,53 ± 112,07	803,82 ± 30,97	755,39 ± 31,21	824,39 ± 80,10 ^{NS}	882,81 ± 26,64 ^{NS}	780,65 ± 33,94 ^{NS}
Sodium	2,48 ± 0,09	2,46 ± 0,09	2,24 ± 0,10	2,47 ± 0,06 ^{NS}	2,25 ± 0,08 ^{NS}	1,97 ± 0,10
Iodine	98,70 ± 4,56	85,27 ± 4,78	89,70 ± 6,36	116,43 ± 3,29	140,27 ± 4,10	128,54 ± 6,92
BMI	23,55 ± 0,88	25,30 ± 0,46	28,36 ± 0,55	24,62 ± 0,44 ^{NS}	26,19 ± 0,26 ^{NS}	27,98 ± 0,43 ^{NS}
Physical activity	-	-	-	1,47 ± 0,05	1,76 ± 0,05	2,04 ± 0,15
Alcohol (wine) ml	123,84 ± 12,89	85,19 ± 9,88	70,02 ± 12,35	55,17 ± 8,10	74,89 ± 6,97 ^{NS}	71,44 ± 16,69 ^{NS}

ENIB (Nutrition survey of the Balearic Islands 1999 – 2000)

OBEX (Nutrition survey: Obesity and oxidative stress 2009 – 2010).

All variables are statistically significant between groups (p < 0.05) except those identified as NS (Non-Significant), and were compared by ANCOVA and adjusted by energy intake, sex and age.

Table 4b Comparison of food patterns with the final nutrition objectives 2010, in women for age group in both studies.

	ENIB (1999 – 2000)			OBEX (2009 – 2010)		
	Age group years			Age group years		
	16 – 25 n = 307 (Mean ± SEM)	26 – 45 n = 480 (Mean ± SEM)	46 – 65 n = 382 (Mean ± SEM)	16 – 25 n = 293 (Mean ± SEM)	26 – 45 n = 360 (Mean ± SEM)	46 – 65 n = 154 (Mean ± SEM)
women						
Total carbohydrates	43,73 ± 0,54	41,93 ± 0,40	43,20 ± 0,50	44,73 ± 0,58 NS	42,88 ± 0,49 NS	42,86 ± 0,83 NS
Total fat	39,41 ± 0,47	39,69 ± 0,37	37,59 ± 0,42	37,65 ± 0,51	38,42 ± 0,45	37,50 ± 0,71 NS
SFA	13,91 ± 0,22	13,98 ± 0,18	12,33 ± 0,20	12,41 ± 0,23	12,32 ± 0,22	11,02 ± 0,33
MUFA	17,20 ± 0,27	17,16 ± 0,21	16,18 ± 0,24	16,92 ± 0,29 NS	17,17 ± 0,26 NS	17,06 ± 0,41
PUFA	4,59 ± 0,11	4,71 ± 0,09	4,93 ± 0,11	4,18 ± 0,11	4,45 ± 0,12 NS	4,66 ± 0,18 NS
Cholesterol	350,44 ± 12,15	347,96 ± 7,80	306,19 ± 7,88	330,66 ± 13,06 NS	305,99 ± 9,60	261,68 ± 13,18
Fruit	172,36 ± 12,31	152,87 ± 9,10	179,49 ± 12,69	209,96 ± 12,64	273,93 ± 10,65	377,59 ± 19,98
Vegetables	173,07 ± 10,06	197,26 ± 8,75	216,31 ± 8,27	156,56 ± 10,33 NS	202,67 ± 10,23 NS	194,59 ± 13,02 NS
Dietary fiber	13,92 ± 0,36	15,01 ± 0,30	16,80 ± 0,35	15,86 ± 0,39	16,35 ± 0,37	17,58 ± 0,58
Folate	245,35 ± 8,63	263,39 ± 6,49	295,90 ± 7,50	278,34 ± 9,28	297,15 ± 7,99	323,49 ± 12,54 NS
Calcium	781,56 ± 19,40	812,46 ± 14,15	771,82 ± 15,72	739,90 ± 20,85 NS	766,96 ± 17,42	784,98 ± 26,27 NS
Sodium	1,96 ± 0,04	1,92 ± 0,04	1,72 ± 0,03	1,96 ± 0,04 NS	1,90 ± 0,05 NS	1,62 ± 0,05 NS
Iodine	83,79 ± 2,94	86,52 ± 2,11	84,08 ± 2,34	118,52 ± 3,16	116,59 ± 2,60	126,13 ± 3,91
BMI	21,92 ± 0,38	24,20 ± 0,38	27,49 ± 0,43	23,25 ± 0,25	24,26 ± 0,26	27,32 ± 0,40 NS
Physical activity	-	-	-	1,42 ± 0,04	1,63 ± 0,02	1,79 ± 0,07
Alcohol (wine)	112,43 ± 7,65	95,82 ± 4,41	78,95 ± 4,55	38,36 ± 7,86	42,75 ± 5,16	41,03 ± 7,15

ENIB (Nutrition survey of the Balearic Islands 1999 – 2000)

OBEX (Nutrition survey: Obesity and oxidative stress 2009 – 2010).

All variables are statistically significant between groups ($p < 0,05$) except those identified as NS (Non-Significant), and were compared by ANCOVA and adjusted by energy intake, sex and age.

Manuscript IV

Diet Quality of adult population of Balearic Island evaluated by a Mediterranean adaptation of the Diet Quality Index-International (DQI-I) and Healthy Eating Index (HEI).

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Diet Quality of adult population of Balearic Island evaluated by a Mediterranean adaptation of the Diet Quality Index-International (DQI-I) and Healthy Eating Index (HEI).

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Abstract

Aims: Evaluation of quality diet of adult population of Balearic Island by a (Diet Quality Index-International (DQI-I) and Healthy Eating Index (HEI). **Methods:** The study is a population based cross-sectional nutritional survey carried out in the Balearic Islands, Spain (2009-2010). The target population consisted of all inhabitants living in the Balearic Island aged 16 to 65 years, and the sample population was derived from residents aged 16 to 65 years registered in the official population census of the Balearic Island, the theoretical sample size was set at 1500 individuals and the final sample was of 1388 (93 % participation) and the one specific relative precision of 5% (type I error = 0.05; type II error = 0.10). dietary habits were assessed by means of a semi-quantitative food frequency questionnaire (FFQ), and two 24-hour recall on non-consecutive days. Spanish food consumption tables were used. **Results:** The total score of the DQI-I reached 47% of the possible score (100%). The best achieved score was the adequacy with 25%, followed by the moderation 11% and variety 8%. Overall balance was the weakest area of the diet, according to the DQI-I standards. Regarding the Healthy Eating Index (HEI) score, over 50% of population showed a good diet principally in the components, total grain, meat and beans and saturated fat, and over 50% of population showed a poor diet with minimum score of zero in the components, dark green or orange vegetables or legumes, whole grains, sodium and SoFAAS (Represents the calories from solid fat, alcohol and added sugar), and the components with less percentage of maximum scores were total fruit 19.3% and milk 8.1%. **Conclusions:** The results of this study suggest, that by assessing four major qualities of diet through DQI-I, the index may also provide useful information for nutrition intervention and education programs in determining which areas of diet require improvement. Otherwise, the diet can be assessed through HEI, is a rapid and cheap method to estimate the quality of the diet in the population and in a qualitative manner, providing information of great interest in planning food and nutrition policies at national level.

Key Words

Nutrition survey · Diet Quality Index-International · Healthy Eating Index · Food consumption · Food pattern · Common targets - Balearic Island.

Introduction

The major focus of work in the area of dietary assessment in recent years has been to measure diet quality from diverse perspectives and in a comprehensive manner. Many suggest that a composite measure of diet is a preferred alternative to a single nutrient or food as a measure of diet quality for prevention obesity and associated diseases [Kim S *et al.* 2011; Newby PK *et al.* 2003]. Several such overall diet measures have been developed, including the Diet Quality Index – International (DQI-I) and the Healthy Eating Index (HEI). The DQI-I was developed as a composites assessment of diet based on recommendations made in Diet and Health, the index was subsequently updated to reflect additional aspects of diet quality not addressed in the original index, including variety, moderation, and proportionality, as reflected in the food Guide Pyramid and the Dietary Guidelines for Americans (5th edition), as well as changes in nutritional recommendations policy [Newby PK *et al.* 2003; Haines PS *et al.* 1999]. The DQI-I recently was modified to assess adherence to Mediterranean Dietary Patterns (MDP), because, the Mediterranean Diet (MD) is an eating pattern characterized by a lifestyle and culture that has been reported to contribute to better health and quality of life for those who adhere to it. The main components characterizing this dietary pattern are a high intake of vegetables, fruits, pulses, olive oil and non-refined cereals; a low intake of meat and saturated fats; a moderately high intake of fish (depending on the proximity to the sea); a low-to-moderate intake of dairy products; and a regular but moderate intake of ethanol, primarily in the form of wine and generally during meals. [Bondia-Pons I *et al.* 2010; Mariscal-Arcas M *et al.* 2007; Tur JA *et al.* 2004; Kim S *et al.* 2011]. Moreover, HEI was developed by the US Department of Agriculture as a measure of diet quality for the US population, the HEI included the most prominent components from the Dietary Guidelines for Americans and the Food Guide Pyramid, which wee regarded as the promoting a healthy American Population [Guo X *et al.* 2004]. Assessing diet quality requires focusing on the nutritional elements considered most important in relation to health promotion and disease prevention [Sofi F *et al.* 2008]. The Diet Quality Index – International (DQI-I) and Healthy Eating Index (HEI) are an instruments developed to measure overall diet quality that reflecting a risk gradient for diet related chronic disease [Newby PK *et al.* 2003].

The aim in this paper was evaluation of quality diet of adult population of Balearic Island by a DQI-I and HEI.

Methods

Study design

The study is a population based cross-sectional nutritional survey carried out in the Balearic Islands, Spain (2009-2010).

Sample

The target population consisted of all inhabitants living in the Balearic Island aged 16 to 65 years, and the sample population was derived from residents aged 16 to 65 years registered in the official population census of the Balearic Island, the theoretical sample size was set at 1500 individuals and the final sample was of 1388 (93 % participation) and the one specific relative precision of 5% (type I error = 0.05; type II error = 0.10). The sampling technique included stratification according to geographical area and municipality size, age (three strata), and sex of inhabitants, and randomization into subgroups, with Balearic Islands municipalities being the primary sampling units, and individuals within these municipalities comprising the final sample units. Pregnant women were not considered in this study.

Questionnaires

Participants were administered a dietary questionnaires included two 24 h diet recalls and a semi-quantitative food frequency questionnaire (FFQ) previously validated [Martin-Moreno JM *et al.* 1993] and applied to other studies and surveys over the Spanish population [Tur JA *et al.* 2004; Aranceta J *et al.* 1993; Ribas-Barba L *et al.* 2007]. The FFQ evaluated average consumption over the past year of 145 items (118 of the original validated FFQ plus the most characteristic Balearic Islands foods in order to make easy the interviewee answer), and arranged by food type and meal pattern. Frequency of food consumption was based on times that food items were consumed (per day, week or month). Consumption <1/month was considered no consumption. Daily consumption (g) was determined by dividing the reported amount of the intake by the frequency (d). The period of consumption of seasonal items was also considered. Volumes and portion sizes were reported in natural units, household measures or with the aid of a manual of sets of photographs [Gomez C *et al.* 2007]. Consumption results were compared with dietary guidelines for the Spanish population [Aranceta J & Serra-Majem L. 2001]. The 24 h recalls were carried out twice during the study period, the first in the warm season (May-September) and the second in the cold season

(November-March) to account for the influence of seasonal variations. The questionnaires were administered in the subject's home. A well-trained dietitian administered the survey measures, and verified and quantified the food questionnaires. To avoid bias brought on by day to day intake variability, the questionnaires were administered homogeneously from Monday to Sunday. Conversion of food into nutrients was made using a self-made computerized program based on Spanish [Mataix J *et al.* 2004; Moreiras O *et al.* 2003] and European Food [Feinberg M *et al.* 1995] Composition Tables, and complemented with food composition data available for Balearic food item [Ripoll L. 1992]. Information about food consumption patterns was obtained from the food frequency questionnaire, whereas information of nutrient intake was derived from the average food daily consumption reported in the two 24 h recalls.

Diet Quality Index international (DQI-I), Mediterranean adaptation.

The DQI-I was used the version proposed by Tur *et al.* 2004 & Mariscal-Arcas *et al.* 2007, which focuses on four aspects of high-quality diet (variety, adequacy, moderation and overall balance). Specific diet components are assessed under each category. These categories help users to identify aspects of their diet that may need improvement. The score for each category is the sum of the scores for each component in that category. The total DQI-I score (range 0 – 100 points) is the sum of the scores for the four categories.

Variety. Variety in the diet is evaluated in two ways, i.e. overall variety and variety within protein sources, to assess whether intake comes from diverse sources both across and within food groups. Inclusion of at least one serving of food per day from each of the five food groups (meat/poultry/fish/egg, dairy/beans, grains, fruits, and vegetables) defines the maximum overall variety score. Variety among the protein sources (meat, poultry, fish, dairy, beans and eggs) is included to illustrate the benefits of including diverse sources of food in the diet even within the same food group. Intake of more than half the serving size per day is considered to be meaningful consumption. The variety category score was derived from the information obtained in the food frequency questionnaire. Information about the scoring system is illustrated in Table 2.

Adequacy. This category evaluates the adequacy of intake of those dietary elements that are required to protect against under-nutrition and deficiency disorders. The adequacy of fruit, vegetables, grain and fiber intake is dependent on the energy intake. Thus, for

energy intake of 7118 kJ (1700 kcal), 9211 kJ (2200 kcal) or 11304 kJ (2700 kcal), the maximum score is assigned to a diet containing two, three or four portions of fruit and three, four or five portions of vegetables, respectively. Likewise, the highest score for grain and fiber categories was assigned to daily intakes of ≥ 6 , ≥ 9 and ≥ 11 portion of grain and ≥ 20 , ≥ 25 and ≥ 30 g fiber for the three energy intake levels, respectively.

Protein intake was considered adequate when the proportion of total energy from protein was $>10\%$. Intakes defining the highest score for adequacy of iron, calcium and vitamin C were derived from the recommended daily intakes for Spanish people [Mataix J., et al 2004], which vary according to age and gender.

Moderation. This category evaluates the intake of food and nutrient related to chronic diseases, which may need restriction. A score of 6 points was assigned when total fat was $\leq 30\%$ of total energy/d, 3 points when 30 – 35 % of total energy/d and 0 points when $> 35\%$ of total energy/d (table 2). The ‘empty-calorie food’ component assesses how much a person’s energy supply is dependent on low-nutrient density foods, which provide energy alone and supply scant nutrients. The following were only categorized in the Mediterranean Patterns Dietary (MPD) food pyramid as empty-calorie foods if their use was only ‘occasional and moderate: cold meats, pate, butter, vegetable margarine, bacon, sugar, industrial pastries, sweets, chewing gum, snacks, soda pop and alcoholic drinks. The scoring of empty-calorie foods was also modified, assigning a score of 6 for consumption ≤ 5 times per week, 3 points for 5–10 times per week, and 0 points for consumption >10 times per week (table 2).

Overall balance. This category examines the overall balance of diet in terms of proportions of energy sources and fatty acid composition.

Healthy Eating Index

The Healthy Eating Index (HEI) is a tool to quantify and evaluate the quality of the diet consumed by one population. It comprises 12 components, which are scored on a scale from 0 to M, where M is 5, 10 or 20 according to the component. The maximum total score is 100. Each component is expressed as a ratio of an individual’s intake of specific food or nutrient to their intake of energy, before scoring. The methodology used for assessing diets by Healthy Eating Index (HEI) of the adult population, is suggested by Guenther *et al.* 2007. Population and subpopulation calculated HEI scores first for each individual’s 1-day diet as reported in the OBEX 2009-2011 dietary survey, using data

24 hour recall. To calculate HEI score, a density value for the daily intake of each food group of interest was calculated. To do so, the reported amount of the food group or nutrient consumed was divided by the reported total energy and multiplied by 1,000 ($[\text{total food group or nutrient intake} / \text{total energy intake}] * 1,000$). We then compared that density value with the standard established for the respective component and determined the score respectively as described above,

Statistics

Analyses were performed with SPSS version 19.0. The score of the DQI-I and its four main categories were descriptively summarized, both calculating the mean and standard deviation score obtained for each component of the DQI-I and percentage of the sample in each component subcategory. For main categories and score of the HEI for 12 components were descriptively summarized and adjusted for 1000 kcal. The mean, standard deviation and percentage for each component were also calculated.

Ethics

The present study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects were approved by the Balearic Islands Ethics Committee. Written informed consent was obtained from all subjects and their parents or legal tutors.

Results

The total score of the DQI-I reached 47% of the possible score (100%). The best achieved score was the adequacy with 25%, followed by the moderation 11% and variety 8%. Overall balance was the weakest area of the diet, according to the DQI-I standards (Table 1).

Regarding the variety, only 2.1% daily consumed at least one serving each food group or missed only one food group, while 96% missed 2 to 4 food groups per day, and 14% daily consumed three or more different sources of protein. Regarding the adequacy, a large proportion of the population reported an intake of protein, iron and vitamin C that were 50% higher than recommendations, while only 39% reported an intake of fruit higher than recommendation, over 50% of the population reported an intake of fiber and calcium between 50 to 100% of recommendation, and over 70% of population showed a poor intake of grain group and vegetables group. In the moderation category, only 19.1% and 8.3% of the sample were within the limits set for fat and saturated fat,

respectively. Cholesterol intake was ≤ 300 mg/d in 53% of the population and >400 mg/d in 30.1%. Around 65.1% met the goals for sodium intake, while only 2.9% of the population consumed empty-calorie food less than five times/week. A very poor balance was found for energy-yielding nutrients, while fatty acids ratio was of 87%.

The total score of the HEI reached 50.4% (SD: ± 14.2) of the possible score (100%). The best-achieved score was the components saturated fatty with 8.99% (SD: ± 2.14), followed by meat and beans with 8.21% (SD: ± 3.23) and oils 5.94% (SD: ± 4.13). The values mean minimum was to dark green or orange vegetables or legumes with 0.97% (SD: ± 1.63), whole grains with 1.49% (SD: ± 1.98), total fruit with 2.04% (SD: ± 2.01), totals vegetables with 2.33% (SD: ± 1.76) and sodium 2.74% (SD: ± 3.47) (table 3).

Regarding the Healthy Eating Index (HEI) score, over 50% of population showed a good diet principally in the components, total grain, meat and beans and saturated fat, and over 50% of population showed a poor diet with minimum score of zero in the components, dark green or orange vegetables or legumes, whole grains, sodium and SoFAAS, and the components with less percentage of maximum scores were total fruit 19.3% and milk 8.1% (Table 4).

Discussion

Two diet quality indexes (DQI-I and HEI) were used to evaluate the diet quality of a representative sample of adult population of Balearic Island (16 – 65 years), with high participation rate (93%).

The mean score of the study population to DQI-I was 47.39% of the full score. This result was lower than the mean DQI-I scores reported in others studies as USA and China [Kim S *et al.* 2003; Méjean C *et al.* 2007; Haines PS *et al.* 1999] and lower than young people in Southern Spain [Mariscal-Arcas M *et al.* 2007] but higher than mean scores observed in the last survey released in Balearic Island [Tur JA *et al.* 2004]. The highest scores in the present group were for adequacy and moderation followed for variety and overall balance. Adequacy reflects compliance with prevailing recommendation to ensure a healthy diet. The diet was assigned a high score in this category for intake of protein, grain, iron y vitamin C but a low score for intake of vegetables and grain, fruits and fibre. According to diet moderation, very poor scores were obtained in total fat, saturated fat and empty calories consumption, while that highest score were for cholesterol and sodium. These results reflect the highest or low scores for the sub-components of adequacy, which indicate higher meat consumption

and all empty calories food. Regarding the diet variety component, results showed very poor score for overall food group variety and good score within group variety from protein source. The DQI-I assumes that a diet including various protein sources is also a feature of a good varied diet. Overall balance score was lower, i.e. the proportionality in energy sources and fatty acids composition, in the present sample, the mean ratio of PUFA and MUFA to SFA was 3.61 and macronutrient ratio of 4.58.

Regarding to HEI, the mean score of the study population was 50.42 % of the full score, below the range of 80 – 100 defined as a good diet by the USDA [Tagney CC *et al.* 2001], value similar to DQI-I and those in other studies [Norte-Navarro AI & Ortiz MR. 2011; McNaughton SA *et al.* 2008]. It is important to note that the scoring criterion in the HEI is different to those in the DQI-I; however, the scoring obtained was similarly in both indexes. The adult population of Balearic Island show a predilection for meat and beans, sources of saturated fat, cereals, empty calorie food including alcohol and added sugar, and low intake of fruits and vegetables (dark green or orange vegetables or legumes), with score similar reported in other studios carried in USA [Tangney CC *et al.* 2001; Savoca MR *et al.* 2009]. With respect to intake of oils, contrarily to the DQI in the HEI is evaluated separately (olive oil and others oils). One-third of the population showed a higher intake than the recommendation and was olive oil the high intake (data no showed), because olive oil is a central element of Mediterranean-type diets and makes a key contribution to its health properties. Nevertheless, the large amounts of olive oil traditionally consumed by Mediterranean populations worsen their diet index score because it is considered an immoderate intake of fat [Mariscal-Arcas M *et al.* 2007; Tur JA *et al.* 2004]. According to HEI 30% of population showed a good diet; while over 50% need improvement in eating habits.

The results of this study suggest, that by assessing four major qualities of diet through DQI-I, the index may also provide useful information for nutrition intervention and education programs in determining which areas of diet require improvement [Bond BJ. 2009]. Otherwise, the diet can be assessed through HEI, is a rapid and cheap method to estimate the quality of the diet in the population and in a qualitative manner, providing information of great interest in planning food and nutrition policies at national level [Freedman LS *et al.* 2008]. Both index may well be used feeding patterns of the study population and do appear to be able to quantify risk of some health outcomes, including biomarkers of disease and risk of CVD, some cancers and mortality. [McCullough ML & Willett WC. 2006; Writ A & Collins CE. 2009].

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References

1. Kim S, Haines PS, siega-Riz AM, popkin BM. The Diet Quality Index-International (DQI-I) provides an effective tool for cross-national comparison of diet quality as illustrated by China and the United States. *J Nutr.* 2003; 133: 3476-84
2. Newby PK, Hu FB, Rimm EB, Smith-Warner SA, Feskanich D, Sampson L, Willett WC. Reproducibility and validity of the Diet Quality Index Revised as assessed by use of a food-frequency questionnaire. *Am J Clin Nutr.* 2003; 78:941-9
3. Haines PS, Siega-Ruiz AM, Popkin BM. The diet Quality Index Revised: A measurement Instrument for population. *J Am Diet Assoc.* 1999; 99:697-704
4. Bondia-Pons I, Mayneris-Perxachs J, Serra.Majem L, Castellote AI, López-Sabater MC. Diet Quality of a population sample from coastal north-east Spain evaluated by a Mediterranean adaptation of the diet quality index (DQI). *Public Health Nutr.* 2010; 13:12-24
5. Tur JA, Romaguera D and Pons A. Adherence to the Mediterranean dietary patterns among the population of the Balearic Island. *Brit J Nutr.* 2004; 92:341-346
6. Mariscal-Arcas M, Romaguera D, Rivas A, Feriche B, Pons A, Tur JA, Olea-Serrano F. Diet Quality of young people in suthern spain evaluated by a Mediterranean adaptation of the Diet Quality Index-International (DQI-I). *Brit J Nutr.* 2007; 98:1267-1273
7. Guo X, Warden BA, Paeratakul S and Bray GA. Healthy Eating Index and obesity. *Eur J Clin Nutr.* 2004; 58:1580-1586
8. Sofi f, Cesari F, Abbate R, Gensini GF, Casini A. adherence to Mediterranean diet and health status: Meta-analysis. *BMJ* 2008;337-1344
9. Martin-Moreno JM, Boyle P, Gorgojo L, , Maisonneuve P, Fernandez-Rodriguez JC, Salvini S, Willett WC: Development and validation of a food frequency questionnaire in Spain. *Int J Epidemiol.* 1993; 22:512-519.
10. Tur JA, Romaguera D, Pons A: Food Consumption Patterns in a Mediterranean Region: Does the Mediterranean Diet Still Exist? *Ann Nutr Metab.* 2004; 48:193-201.
11. Aranceta J, Perez C, Gondra J, Gonzalez de Galdeano L, Saenz de Buruaga J: Fat and alcohol intake in the Basque Country. *Eur J Clin Nutr.* 1993;47 Suppl 1:S66-S70.

12. Ribas-Barba L, Serra-Majem L, Salvador G, Castell C, Cabezas C, Salleras L, Plasencia A: Trends in dietary habits and food consumption in Catalonia, Spain (1992–2003). *Public Health Nutr* 2007; 10:1340-1353.
13. Gomez C, Kohen VL, Nogueira TL: *Guía visual de alimentos y raciones*. Madrid: EDIMSA, 2007.
14. Aranceta J, Serra-Majem L: Dietary guidelines for the Spanish population. *Public Health Nutr* 2001; 4:1403-1408.
15. Mataix J, Mañas M, Llopis J, Martínez de Victoria E, Juan J & Borregón A (2004) *Tablas de composición de alimentos españoles (Spanish food composition tables)*, 4th ed. Granada: INTA-Universidad de Granada.
16. Moreiras O, Carbajal A, Cabrera L & Cuadrado C (2003) *Tablas de composición de alimentos (Food composition tables)*, 7th ed. Madrid. Pirámide.
17. Feinberg M, Favier JC & Ireland-Ripert J (1995) *Répertoire général des aliments*. París: Tec & Doc Lavoisier.
18. Ripoll L (1992) *Cocina de las Islas Baleares (The Balearic Islands Cookery)*, 5th ed. Palma de Mallorca: L. Ripoll.
19. Gunther PM, Reedy J, Krebs-Smith SM, Reeve BB, Basiotis PP. Development and Evaluation of the Healthy Eating Index-2005. Technical Report. Center for Nutrition Policy and Promotion, U.S. Department of Agriculture. Available at <http://www.cnpp.usda.gov/HealthyEatingIndex.htm>.
20. Méjean C, Traissac P, Eymard-Duvernay S, Ati JE, Delpuech F, Maire B. Diet Quality of North African Migrants in France Partly explains their lower prevalence of diet-related chronic conditions relative to their native French peers. *J Nutr*. 2007; 137; 2106-2113.
21. Tangney CC, Evans DA, Bianias JL, Morris MC. Healthy eating index of black and white older adults. *Nutr Research* 2001; 21:1411-1423.
22. Norte-Navarro AI & Ortiz MR. Calidad de la dieta española según el índice de alimentación saludable. *Nutr Hosp*. 2011; 26:330-336-.
23. McNaughton SA, Ball K, Crawford D, Mishra GD. An Index diet and eating patterns is a valid measure of diet quality in an Australian population. *J Nutr*. 2008; 138:86-93.
24. Savoca MR, Arcury TA, Leng X, Bell RA, Chen H, Anderson A, Kohrman T, Quandt SA. The diet quality of rural older adults in the South as measured by Healthy Eating Index-2005 varies by ethnicity. *J Am Diet Assoc*. 2009; 109:2063:2067.

25. Bond BJ. The Mediterranean diet and your health. Downloaded from <http://ajl.sagepub.com> at UNIV OF MIAMI on January 13, 2009.
26. Freedman LS, Gunther PM, Krebs-Smith SM, Kott PS. A population's mean Healthy eating Index-2005 score are best estimated by the score of the population ratio when one 24-hour recall is available. *J Nutr.* 2008; 138:1725-1729.
27. McCullough ML & Willett WC. Evaluating adherence to recommended diets in adults: the alternate Healthy Eating Index. *Public Health Nutr.* 2006; 9; 152-7.
28. Wirt A & Collins CE. Diet quality-wath is it and does it matter? *Public Health Nutr* 2009; 12; 2473-92.

Table 1. Diet Quality Index-International (DQI-I) scores and component in adult population of Balearic Island 2009 – 2010.

Component	Score ranges (points)	Mean	SD
DQI-I	0 - 100	47.39	8.41
Variety	0 - 20	8.06	3.59
Overall food Group variety	0 - 15	5.45	2.27
Within-group variety from protein source	0 - 5	2.61	1.34
Adequacy	0 - 40	24.91	4.74
Vegetable group	0 - 5	1.31	0.94
Fruit Group	0 - 5	3.06	1.74
Grain group	0 - 5	1.7	1.25
Fibre	0 - 5	3.05	1.32
Protein	0 - 5	4.92	0.41
Iron	0 - 5	3.95	1.25
Calcium	0 - 5	2.72	1.38
Vitamin C	0 - 5	4.2	1.4
Moderation	0 - 30	10.47	5.36
Total fat	0 - 6	1.71	2.38
Saturated fat	0 - 6	1.19	1.91
Cholesterol	0 - 6	3.68	2.65
Sodium	0 - 6	4.58	2.12
Empty calorie food	0 - 6	0.39	1.24
Overall balance	0 - 10	3.95	1.58
Macronutrient (carbohydrate-protein-fat)	0 - 6	4.58	2.12
Fatty acid ratio (PUFA+MUFA)/SFA	0 - 4	3.61	1.11

Table 2. Components of the Diet Quality Index (DQI-I) and percentage of sample in component subcategories of adult population of Balearic Island 2009-2010.

Component	Score ranges	Points	Scoring criteria	%
Variety	0 - 20			
Overall food Group variety	0 - 15	15	≥ 1 serving from each food Group/d	0,3
		12	Any 1 food Group missing/d	1,8
		9	Any 2 food Group missing/d	11,7
		6	Any 3 food Group missing/d	53,7
		3	≥ 4 food groups missing/d	30,3
		0	None from any food group	2,1
Within-group variety from protein source	0 - 5	5	≥ 3 different sources/d	13,9
		3	2 different sources/d	53,7
		1	From 1 source/d	30,3
		0	None	2,1
Adequacy	0 - 40			
Vegetable group*	0 - 5	5	> 100 % recommendations	3.1
		3	50 – 100 % recommendations	11.2
		1	< 50 % recommendations	82.2
		0	0 % recommendations	3.6
Fruit Group*	0 - 5	5	> 100 % recommendations	38.8
		3	50 – 100 % recommendations	26.6
		1	< 50 % recommendations	32.1
		0	0 % recommendations	2.4
Grain group*	0 - 5	5	> 100 % recommendations	8.1
		3	50 – 100 % recommendations	19.1
		1	< 50 % recommendations	72.5
		0	0 % recommendations	0.3
Fibre*	0 - 5	5	> 100 % recommendations	23.0
		3	50 – 100 % recommendations	56.5
		1	< 50 % recommendations	20.5
		0	0 % recommendations	0.1
Protein	0 - 5	5	> 100 % recommendations	96.3
		3	50 – 100 % recommendations	3.5
		1	< 50 % recommendations	0.1
		0	0 % recommendations	0.1
Iron [†]	0 - 5	5	> 100 % recommendations	54.3
		3	50 – 100 % recommendations	38.7
		1	< 50 % recommendations	7.0
		0	0 % recommendations	0.0
Calcium [†]		5	> 100 % recommendations	17.7
		3	50 – 100 % recommendations	50.7
		1	< 50 % recommendations	31.7
		0	0 % recommendations	0.0
Vitamin C [†]	0 - 5	5	> 100 % recommendations	72.5
		3	50 – 100 % recommendations	15.3
		1	< 50 % recommendations	11.9
		0	0 % recommendations	0.3
Moderation	0 - 30			
Total fat	0 - 6	6	≤ 30 % of total energy/d	19.1
		3	> 30 – 35 % of total energy/d	18.8
		0	> 35 % of total energy/d	62.0
Saturated fat	0 - 6	6	≤ 7 % of total energy/d	8.3
		3	> 7 – 10 % of total energy/d	23.3
		0	> 10 % of total energy/d	68.4
Cholesterol	0 - 6	6	≤ 300mg/d	53.0
		3	> 300 – 400 mg/d	16.9
		0	> 400 mg/d	30.1
Sodium	0 - 6	6	≤ 2400 mg/d	65.1
		3	> 2400 – 3400 mg/d	22.5
		0	> 3400 mg/d	12.4
Empty calorie food	0 - 6	6	< 5 times/week	2.9
		3	> 5 – 10 times/week	7.1
		0	> 10 times/week	90.0

Table 2. Continued.

Component	Score ranges	Points	Scoring criteria	%
Overall balance	0 - 10			
Macronutrient (carbohydrate-protein-fat)	0 - 6	6	55-65:10-15:15-25	3.4
		4	52-68:9-16:13-27	1.9
		2	50-70:8-17:12-30	3.5
		0	Otherwise	91.2
Fatty acid ratio (PUFA+MUFA)/SFA	0-4	4	> 2	87.4
		2	1.7 - 2	5.1
		0	< 1.7	7.4

* Based on 7118 kJ(1700 kcal), 9211 kJ(2200 kcal), 11304 kJ (2700 kcal).

† Based on the recommended daily intakes for Spanish people [Mataix J et al 2004].

PUFA=polyunsaturated fatty acids; MUFA=monounsaturated fatty acids; SFA= Saturated fatty acids.

Table 3. Healthy Eating Index (HEI) score and components in adult population of the Balearic Island 2009 – 2010.

	Score ranges (points)	Mean	SD
HEI-Total	0 - 100	50.42	14.3
Total Fruit (includes 100% juice)	0 - 5	2.04	2.01
Whole Fruit (not juice)	0 - 5	2.41	2.3
Total Vegetables	0 - 5	2.33	1.76
Dark Green or Orange Vegetables or Legumes	0 - 5	0.97	1.63
Total Grains	0 - 5	4.11	1.5
Whole grains	0 - 5	1.49	1.98
Milk ¹	0 - 10	4.75	2.88
Meat and Beans	0 - 10	8.21	3.23
Oils ²	0 - 10	5.94	4.13
Saturated Fat	0 - 10	8.99	2.14
Sodium	0 - 10	2.74	3.47
Calories from SoFAAS ³	0 - 20	6.44	8.43

¹Includes milk and dairy products.

²Includes only olive oil and other oils.

³Calories from SoFAAS = (Represents the calories from solid fat + calories from alcohol + calories from added sugar).

Table 4. Components of Healthy Eating Index (HEI) and the percentage of points in the sample of adult population of Balearic Island 2009 – 2010^a

	Score ranges (points)	Scoring criteria	%
Total Fruit (includes 100% juice)	0 - 5		
	5	?0.8 cup equiv per 1000 kcal	19.3
	0	No fruit	39.9
Whole Fruit (not juice)	0 - 5		
	5	?0.4 cup equiv per 1000 kcal	35.8
	0	No whole fruit	44.3
Total Vegetables	0 - 5		
	5	?1.1 cup equiv per 1000 kcal	15.3
	0	No vegetables	17.6
Dark Green or Orange Vegetables or Legumes	0 - 5		
	5	?0.4 cup equiv per 1000 kcal	8.6
	0	Vegetables or Legumes	66.2
Total Grains	0 - 5		
	5	?3.0 oz equiv per 1000 kcal	64.2
	0	No Grains	5.7
Whole grains	0 - 5		
	5	?1.5 oz equiv per 1000 kcal	14.6
	0	No Whole Grains	58.8
Milk	0 - 10		
	10	?1.3 cup equiv per 1000 kcal	8.1
	0	No milk	8.8
Meat and Beans	0 - 10		
	10	?2.5 oz equiv per 1000 kcal	68.6
	0	No meat and beans	7.4
Oils	0 - 10		
	10	?12 grams per 1000 kcal	34.5
	0	No oil	27.4
Saturated Fat	0 - 10		
	10	?7% of energy	66.2
	0	?15% of energy	2.2
Sodium	0 - 10		
	10	?0.7 grams per 1000 kcal	6
	0	?2.0 grams per 1000 kcal	50
Calories from SoFAAS	0 - 20		
	20	?20% of energy	19.9
	0	?50% of energy	55.7

^a Intake between the minimum and maximum levels are scored proportionately.

¹ Includes milk and dairy products.

² Includes only olive oil and other oils.

³ Calories from SoFAAS = (Represents the calories from solid fat + calories from alcohol + calories from added sugar).

Manuscript V

Trends in energy and nutrient intake in adult population of Balearic Island, Spain (1999 – 2010).

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Trends in energy and nutrient intake in adult population of Balearic Island, Spain (1999 – 2010).

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Abstract

Aims: The purpose of this article is to analyse the trends in energy and nutrient intake in adult population of Balearic Island, Spain (1999 – 2010). **Methods:** The nutritional data from the present study are derived from the last two Balearic Island Nutritional Survey carried out in 1999 – 2000 (ENIB) and 2009 – 2010 (OBEX). The sample population was derived from residents aged 16-65 years registered in the official population census of the Balearic Island. The response rates in both surveys were of 97%. The present analysis is based on data from 2843 individuals aged 16 – 65 years, pooled from the two survey (867 men and 1976 women): 1455 belonged to ENIB 1999 – 2000 (286 men and 1169 women) and 1388 belonged to OBEX 2009 – 2010 (581 men and 807 women). A 24-hour recall was used for dietary assessment. Nutrient intake was assessed by calculating the percentage population with intakes \geq RDI, \leq RDI, $< 2/3$ RDI, $< 1/3$ RDI. The results of each survey are shown according to age group and gender. **Results:** Between 1999 – 2010, mean percentage of energy from protein decreased from 17.94 % (SD: \pm 5.94) to 16.92% (SD: \pm 4.98) ($p < 0.05$) in males, while women no significant variation, carbohydrates showed increased only in men 41.73% (SD: \pm 9.40) to 44.81% (SD: \pm 9.57) ($p < 0.001$). The fats decreased 38.45% (SD: \pm 8.64) to 36.82% (SD: \pm 8.41) ($p < 0.01$). Cholesterol decreased in men from 420.09 mg day⁻¹ to 364.93 mg day⁻¹ ($p < 0.001$). With respect to fruit and vegetables intake was observed a increased in men from 317.6 g day⁻¹ to 387.9 g day⁻¹ ($p < 0.001$) and women 365.2 g day⁻¹ to 456.9 g day⁻¹ ($p < 0.001$). Fibre intake increased from 16.28 g day⁻¹ to 18.19 g day⁻¹ in men and women from 15.08 g day⁻¹ to 17.04 g day⁻¹ ($p < 0.001$). A slight decreased was observed in the intake of sodium only in women from 1.79 g day⁻¹ to 1.99 g day⁻¹ ($p < 0.001$). A decreased in the percentage of men and women with intakes $< 1/3$ of to RDI was observed in iron, iodine, thiamine, vitamin D and niacin. Magnesium, zinc, vitamin B6, vitamin C and folic acid only the decreased was observed in women. In general, a significance decrease in the percentage of men and women with intake under the RDI was observed, in Iron, thiamine, vitamin B6, vitamin D, Niacin and folic acid. **Conclusions:** The changes observed in dietary characteristics show the influence in the decreased of the population with intake $<$ of the RDI, which influences in decreased the percentage of population with intake $< 2/3$ of the RDI and $< 1/3$ of the RDI. These changes are not sufficient, for this reason, it is necessary to encourage cooperation and

coordination to establish policies necessary to prevent drastic changes in its traditional Mediterranean diet.

Introduction

The World Health Organization (WHO) alerts in their World Health Report 2002 that in most developed countries, a great proportion of the morbidity and mortality are related to non-communicable diseases, and that the main risk factors (hypertension, hypercholesterolemia, low fruit and vegetable consumption, overweight or obesity, physical inactivity and tobacco smoking) are largely related to inadequate food habits and low physical activity levels in the population [Serra-Majem L *et al.* 2007]. The increasing prevalence of overweight in the world could be the result of an upward shift in energy intake, a downward shift in energy expenditure, or both. A high dietary intake of saturated fat (SFA) and cholesterol is associated with an increased risk of coronary disease, whereas a higher intake of monounsaturated (MUFA) and polyunsaturated fat (PUFA) reduces this risk. The benefits from a diet rich in fruit and vegetables and fiber, are also well established [Perrin AE *et al.* 2002]. Various foods and nutrients have been linked to incidence and prevention of chronic diseases in different populations. It highlights research on the effect of antioxidant vitamins A, E and C in preventing cancer and cardiovascular disease, as well as the interest in folate and metabolically related B-vitamins (B12, B6 and riboflavin) that may protect against cardiovascular disease (particularly stroke) and certain cancers, and may have other important roles in cognitive function and bone health [Mc Nulty H & Scott JM. 2008]. Many studies had demonstrated that energy intake and nutrient have relation with other factors as socioeconomic, education level, site and time of meals [Tabacchi G *et al.* 2009]. Therefore, the evaluation of a population's nutritional status is a key element for the development of public health policies to promote healthy nutritional habits according to evidence-based epidemiology; it would facilitate the evaluation of trends in food consumption, eating habits and the prevalence of health-related risk factors (sedentary lifestyles, smoking, etc.) [Serra-Majem L *et al.* 2007].

The latest nutrition survey in Balearic Island was realized in 2009 – 2010 (OBEX 2009 – 2010), whose objectives, methodology and parameters to analyse were very similar to the previous survey (ENIB 1999 – 2000). It included a representative sample of individuals aged 16 to 65 years, this allowed for the evaluation of the populations current nutritional status as well as for the identification of trends in specific indicators

over the 10-years period of evolution. The purpose of this article is to analyse the trends in energy and nutrient intake in adult population of Balearic Island, Spain (1999 – 2010).

Methods

Study design

The nutritional data from the present study are derived from the last two Balearic Island Nutritional Survey carried out in 1999 – 2000 (ENIB) and 2009 – 2010 (OBEX).

Sample

Samples were selected by considering the proportion of the number inhabitants and the specific weight of each municipality in the sample and the sample population was derived from residents aged 16-65 years registered in the official population census of the Balearic Island. The response rates in both surveys were of 97 %, the present analysis is based on data from 2843 individuals aged 16 to 65 years, pooled from the two survey (867 men and 1976 women): 1455 belonged to ENIB 1999 – 2000 (286 men and 1169 women) and 1388 belonged to OBEX 2009 – 2010 (581 men and 807 women). 3% of the sample was under-report.

Questionnaires

A 24-hour recall was used for dietary assessment. Both in survey ENIB (1999 – 2000) and OBEX (2009- 2010), the 24-hour recall were carried out twice during the study period, the first in the warm season (May-September) and the second in the cold season (November-March) to account for the influence of seasonal variations. The questionnaires were administered in the subject's home. A well-trained dietitian administered the survey measures, and verified and quantified the food questionnaires. To avoid bias brought on by day to day intake variability, the questionnaires were administered homogeneously from Monday to Sunday. Conversion of food into nutrients was made using a self-made computerized program based on Spanish [Mataix J *et al.* 2004; Moreiras O *et al.* 2003] and European Food [Feinberg M *et al.* 1995] Composition Tables, and complemented with food composition data available for Balearic food item [Ripoll L. 1992]. Information about food consumption patterns was obtained from the food frequency questionnaire, whereas information of nutrient intake was derived from the average food daily consumption reported in the two 24 h recalls.

Statistics

Analyses were performed with SPSS version 19.0. The differences of mean intakes for energy and nutrients by gender in both studies were analyzed. Comparisons also included percentage of energy intake from fat, carbohydrate and proteins calculated from the following conversion factors – proteins: 4 kcal g⁻¹; carbohydrates: 4 kcal g⁻¹; fats: 9 kcal g⁻¹. Nutrient intake was assessed by calculating the percentage population with intakes \geq RDI, \leq RDI, $< 2/3$ RDI, $< 1/3$ RDI. The results of each survey are shown according to age group and gender. -

Statistical analysis included ANCOVA to compare means between surveys and adjusted by age and corrected by sequential Bonfferoni's test to control type-1 error. The χ^2 statistics were used for comparisons of proportions. The level of significance was established for *P* values < 0.05 .

Results

Table 1 showed the trends of food patterns in the adult population aged 16 to 65 years in men and women. The table compares the energy percentage distribution of dietary characteristics with recommended ranges WHO/FAO for each survey. The difference between the two surveys ENIB (1999 – 2000) and OBEX (2009 – 2010) and statistical significance are also presented. Mean percentage of energy from protein decreased very slightly from 17.94 % (SD: ± 5.94) to 16.92% (SD: ± 4.98) ($p < 0.05$) in males, while women no significant variation. Mean percentage of energy from carbohydrates showed increased only in men from 41.73% (SD: ± 9.40) to 44.81% (SD: ± 9.57) ($p < 0.001$). The percentage of energy provided by fats decreased only men from 38.45% (SD: ± 8.64) to 36.82% (SD: ± 8.41) ($p < 0.01$). A significant decreased in saturated fatty acids (SFA) was observed in both sexes, in men from 13.18% (SD: ± 4.04) to 12.17 % (SD: ± 3.92) and women from 13.30 % (SD: ± 4.05) to 12.27% (SD: ± 4.25) ($p < 0.001$). Only women showed a slight increased in percentage of energy provided from monounsaturated fatty acids (MUFA) from 16.71% (SD: ± 4.76) to 17.26% (SD: ± 5.32) ($p < 0.05$). Men and women showed a decreased in percentage of energy provided from polyunsaturated fatty acids, men from 4.81% (SD: ± 2.41) to 4.21% (SD: ± 1.86) ($p < 0.001$) and women from 4.69% (SD: ± 2.29) to 4.44% (SD: ± 1.81) ($p < 0.05$). Cholesterol decreased only in men from 420.09 mg day⁻¹ to 364.93 mg day⁻¹ ($p < 0.001$). With respect to fruit and vegetables intake was observed a increased in men

from 317.6 g day⁻¹ to 387.9 g day⁻¹ (p < 0.001) and women from 365.2 g day⁻¹ to 456.9 g day⁻¹ (p < 0.001). Fibre intake increased from 16.28 g day⁻¹ to 18.19 g day⁻¹ in men and women from 15.08 g day⁻¹ to 17.04 g day⁻¹ (p < 0.001). A slight decreased was observed in the intake of sodium only in women from 1.79 g day⁻¹ to 1.99 g day⁻¹ (p < 0-001).

Table 2 showed the trends in nutrient consumption in men and women age 16 to 65 years of Balearic Island from 1999 to 2010. Nutritional adequacy is assessed in these tables through the use of four parameters: percentage of men and women with intakes ≥ of the RDI, < of the RDI, < 2/3 of the RDI and <1/3 to the RDI. A decreased in the percentage of men and women with intakes < 1/3 of to RDI was observed in iron, from 11.1 % to 6.3 in men (p < 0.01), from 45.1% to 27.3% in women (p < 0.001), iodine from 68.0 % to 39.1 % in men (p < 0.001) and from 69.9 % to 41.4% in women (p < 0.001), thiamine from 16.7 % to 11.2% in men (p < 0.01) and from 22.6% to 11.4 % in women (p < 0.001), vitamin D from 69.1% to 58.3% in men (p < 0.001) and from 76.2% to 67.9% in women (p < 0.001) and niacin from 23.7% to 17.2% in men (p < 0.01) and from 27.4% to 15.4% in women (p < 0.001), while magnesium, zinc, vitamin B6, vitamin C and folic acid only the decreased was observed in women. In general, a significance decrease in the percentage of men and women with intake under the RDI was observed, in Iron from 36.9% to 27.5% in men (p < 0.05) and from 78.3% to 40.9% in women (p < 0.001), iodine from 88.3% to 69.1% in men (p < 0.001) and from 91.3% to 72.8% in women (p < 0.001), thiamine from 52.0% to 32.3% in men (p < 0.01) and from 59.4% to 37.5% in women (p < 0.001), vitamin B6 from 41.3% to 32.8% in men (p < 0.01) and from 46.9% to 31.6% in women (p < 0.001), vitamin D from 90.35 to 82.7% in men (p < 0.001) and from 92.3% to 89.75 in women (p < 0.001), Niacin from 50.8% to 38.2% in men (p < 0.01) and from 53.4% to 36.2% in women (p < 0.001) and folic acid from 82.6% to 76.1 in men (p < 0.05) and from 85.2% to 77.3% in women (p < 0.001).

Table 3 showed trends in nutrient consumption in the adult population of Balearic Island from 1999 to 2010 by age group. An significant increased in the percentage of population with intake ≥ of the RDI was observed, in Iron from 26.2% to 49.7% in age group 16 to 25 years (p < 0.001) and from 25.9% to 52.8% in age group 26 to 45 years (p < 0.001) and from 43.7% to 68.3% in age group 46 to 65 years (p < 0.001), iodine

from 12.7% to 27.6% in age group 16 to 25 years ($p < 0.001$), from 7.2% to 28.6% in age group 26 to 45 years ($p < 0.001$) and from 9.2% to 32.2% in age group 46 to 65 years ($p < 0.001$), thiamine from 49.0% to 66.05 in age group 16 to 25 years ($p < 0.001$) from 41.9% to 64.0% in age group 26 to 45 years ($p < 0.001$) and from 36.5% to 63.0% in age group 46 to 65 years ($p < 0.001$), vitamin B6 from 58.7% to 67.0% in age group 16 to 25 years ($p < 0.01$) from 55.5% to 69.8% in age group 26 to 45 years ($p < 0.001$) and from 48.9% to 65.6% in age group 46 to 65 years ($p < 0.001$), niacin from 50.4% to 61.4% in age group 16 to 25 years ($p < 0.001$) from 46.2% to 64.2% in age group 26 to 45 years ($p < 0.001$) and from 45.4% to 63.9% in age group 46 to 65 years ($p < 0.001$) and folic acid from 12.7% to 18.2% in age group 16 to 25 years ($p < 0.05$) from 14.45 to 26.2% in age group 26 to 45 years ($p < 0.001$) and from 19.5% to 28.6% in age group 46 to 65 years ($p < 0.01$). Therefore, the decreased in the percentage of the population with intake $<$ of the RDI, $< 2/3$ of the RDI and $< 1/3$ of the RDI were noteworthy. Phosphorus showed decreased in age group 16 to 25 years with intake \geq of the RDI from 80.7% to 70.1% ($p < 0.001$), while in age group 26 to 45 years increased from 89.9% to 94.6% ($p < 0.01$). Vitamin D showed increased from 6.7% to 13.3% in age group 16 to 25 years ($p < 0.001$) and from 8.45 to 13.4% in age group 26 to 45 years ($p < 0.01$). Vitamin E only showed changes in age group 16 to 25 years with decreased from 41.5% to 29.6% ($p < 0.001$). Calcium and vitamin B12 only showed increased in age group 26 to 45 years, from 15.4% to 21.5% and from 76.3% to 83.2% ($p < 0.01$) respectively. Zinc showed increased in age group 26 to 45 years from 18.5% to 21.5% and from 14.4% to 20.7% in age group 46 to 65 years ($p < 0.05$). Vitamin C showed increased in age groups 26 to 45 years from 65.1% to 74.5% ($p < 0.001$) and from 72.9% to 82.8% in age group 46 to 65 years ($p < 0.01$).

Discussion

This article presents data derived from the Nutrition Survey of the Balearic Island conducted in 1999 – 2000 (ENIB 1999 – 2000) and Nutrition Survey: Obesity and Oxidative Stress 2009 – 2010 (OBEX 2009 – 2010) in representative population sample aged 16 to 65 years. Both survey follow very similar methodologies, having used the same food composition tables and the same nutritional assessment method consisting of two 24-hours recalls in part of or in the totality of the sample. The data from ENIB

1999 – 2000 were recoded and re-analysed according to the food composition tables used in OBEX 2009 – 2010.

Current trends of energy and nutrient intake reflect the variations in the last decade in food patterns of adult population of the Balearic Island. We have observed that dietary characteristics showed an increased in percentage of energy provide of protein, fat, saturated fatty acids and cholesterol. However, the percentage of energy provided by protein and saturated fat showed a slight decrease but higher than the recommended values. This increased is partly to the products meat intake as sausage, cold cuts, eggs and dairy products principally, data similar in other regions of Spain [Wang Y *et al.* 2010; Serra-Majem L *et al.* 2007; Serra-Majem L *et al.* 1993; Serra-Majem L *et al.* 2000]. Monounsaturated fatty acid, polyunsaturated fatty acid, fibre and fruit and vegetables remain lower to recommendation in both surveys, however, in OBEX 2009 – 2010, the percentage of energy of MUFA and PUFA showed a slight decreased, while fibre, fruit and vegetables showed a slight increased. These results of the present study are in accordance with other studies carried in Spain and other countries [Krachler B *et al.* 2005; Varela-Moreiras G *et al.* 2010; Aranceta J *et al.* 1998]. It is worth highlighting from the results previously cited the increased percentage of energy that provide the proteins, fat, SFA, cholesterol and the decreased of percentage energy consumption provided from CHO, MUFA, PUFA, fibre, fruit and vegetables, have an important impact on micronutrient intake [Farmer B *et al.* 2011]. These trends are somewhat variable according to age and sex. The low intake of fruits and vegetables in a smaller proportion has had a considerable impact on the marked decreased of vitamins and minerals, as well as on that of other nutrients such as fibre [Serra Majem L *et al.* 2007; Ribas Barba L *et al.* 2007]. Multiple factors may be responsible for increasing energy intake, as portion size of foods, number of meals eaten away from home, frequency of eating episodes, temporal distribution of food intake, and energy density of foods, may relate with energy intake. [Kant Ka & Grabard BI. 2006; Wu SJ *et al.* 2011; Flood VM *et al.* 2010].

The changes observed in dietary characteristics show the influence in the decreased of the population with intake < of the RDI, which influences the percentage of population with intake < 2/3 of the RDI and < 1/3 of the RDI. In both sexes, was observed a decreased percentage of population with intake < of the RDI and < 1/3 of the RDI of

iron, iodine, thiamine, vitamin B6, vitamin D, Niacin and folic acid. A decreased of population with intake $<$ of the RDI of phosphorus, vitamin E and pantothenic acid was observed only in men. While a decreased of population with intake $< 1/3$ of the RDI of magnesium, $< 2/3$ of the RDI of Zinc and $< 1/3$ of the RDI of vitamin C was observed only in women. Despite positive changes observed in this study, over 50% of the adult population showed an intake $<$ of the RDI of magnesium, calcium, iodine, iron, zinc, retinol, vitamin D, vitamin E, pantothenic acid and folic acid, data similar in other studies were observed [Al-Tahan J *et al.* 2006; Wu SJ *et al.* 2011; Pan WH *et al.* 2011; Fulgoni V *et al.* 2007; Tabacchi G *et al.* 2009].

When comparing both survey for age groups, a increased of population with intake \geq of the RDI of iron, iodine, thiamine, vitamin B6, niacin and folic acid was observed in all age groups, which influence a decreased the percentage of population with intake $< 2/3$ of the RDI and $< 1/3$ of the RDI. A decreased of population with intake \geq of the RDI of phosphorous was observed in age group 16 to 25 years, while age group 26 to 45 years showed increased. The increased was also observed for vitamin D in age groups 16 to 25 and 26 to 45 years, vitamin E in age group 16 to 25 years, calcium and vitamin B12 in age group 26 to 45 years, zinc and vitamin C in age groups 26 to 45 and 46 to 65 years [McNulty H & Scott JM. 2008; Cashman KD & Flynn A. 1999]. In this study we observed also that in the case of antioxidants such as selenium, showed no significant changes, 80% of the population has intake \geq of the RDI. The zinc intake increased mainly in women 78.8% of the population has intake \geq of the RDI the changes were observed mainly age groups 26 to 45 and 46 to 65 years. The Vitamin C show slight changes mainly in woman, a decreased in the percentage of population with intake $<$ of the RDI and $< 1/3$ of the RDI was observed, mainly in the age 26 to 45 and 46 to 65 years. Moreover, a increased of the percentage of men from 16 to 25 years with intake $<$ of the RDI of vitamin E was observed, low or moderate intake of antioxidants is similar with results from other studies [Tur JA *et al.* 2005; Pinheiro MM *et al.* 2011]. A high intake of fresh fruit, root vegetables and fruiting vegetables is associated with reduced mortality, probably as a result of their high content of vitamin C, carotenoids and lycopene, lower mortality was associated with greater adherence to a Mediterranean diet in elderly from several European countries and with the recommended foods behaviour score (RFBS) in the National Health Interview Surveys from United States [Agudo A *et al.* 2007]. The results indicate that changes are not sufficient, by showing some

deterioration in the quality of the diet expressed as lower coverage of RDI of certain nutrients. For this reason, it is necessary to encourage cooperation and coordination to establish policies necessary to prevent drastic changes in its traditional Mediterranean diet [Toffanello ED *et al.* 2011].

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References

1. Mataix J, Mañas M, Llopis J, Martínez de Victoria E, Juan J & Borregón A (2004) *Tablas de composición de alimentos españoles (Spanish food composition tables)*, 4th ed. Granada: INTA-Universidad de Granada.
2. Moreiras O, Carvajal A, Cabrera L, Cuadrado C: *Tablas de composición de alimentos (Food Composition Tables)*, ed 7th. Madrid: Pirámide, 2003.
3. Feinberg M, Favier JC & Ireland-Ripert J (1995) *Répertoire général des aliments*. París: Tec & Doc Lavoisier.
4. Ripoll L (1992) *Cocina de las Islas Baleares (The Balearic Islands Cookery)*, 5th ed. Palma de Mallorca: L. Ripoll.
5. Wang Y, Beydoun MA, Caballero B, Gary TL, Lawrence R. Trends and correlates in meat consumption patterns in the Us adult population. *Public Health Nutr.* 2010; 13:1333-45.
6. Serra-Majem L, Ribas-Barba L, Salvador G, Serra J, Castell C, Cabezas C, Plasencia A. Compliance with dietary guidelines in the Catalan population: basis for a nutrition policy at the regional level (the PAAS strategy). *Public Health Nutr.* 2007; 10:1406-14.
7. Serra-Majem L, Ribas L, Lloveras G, Salleras L. Changing patterns of fat consumption in Spain. *Eur J Clin Nutr.* 1993; 47: 13-20.
8. Serra-Majem L, Armas Navarro A, Ribas Barba L. Food consumption and food sources of energy and nutrients in Canary Islands (1997-98). *Arch Latinoam Nutr.* 2000; 50:23-33.
9. Krachler B, Eliasson M, Stenlund H, Johansson I, Hallmans G, Lindahi B. Trends in food intakes in Swedish adults 1986-1999: findings from the Northern Sweden MONICA (Monitoring of Trends and Determinants in Cardiovascular Disease) Study. *Public Health Nutr.* 2005; 8:628-35.
10. Varela-Moreiras G, Avila JM, Cuadrado C, del Pozo S, Ruiz E, Moreiras O. Evaluation of food consumption and dietary patterns in Spain by the Food Consumption Survey: updated information. *Eur J Clin Nutr.* 2010; 64:37-43
11. Aranceta J, Pérez Rodrigo C, Equiileor I, Marzana I, González de Galdeano L, Saenz de Buruaga J. Food Consumption patterns in the adult population of the Basque Country (EINUT-I). *Public Health Nutr.* 1988; 1:185-92.
12. Farmer B, Larson BT, Fulgoni VL 3rd, Rainville AJ, Liepa GU. A vegetarian dietary patterns as a nutrient-dense approach to weight management: an analysis of the national health and nutrition examination survey 1999-2004. *J Am Diet Assoc.* 2011; 111:819-27.

13. Serra-Majem L, Ribas-Barba L, Salvador G, Jover L, Raidó B, Ngo J, Plasencia A. Trends in energy and nutrient intake and risk of inadequate intake in catalonia, Spain (1992-2003). *Pubic Health Nutr.* 2007; 10:1354-67.
14. Ribas-Barba L, Serra Majem L, Salvador G, Castell C, Cabezas C, Salleras L, Plasencia A. Trends in dietary and food consumption in Catalonia, Spain (1992-2003) *Public Health Nutr.* 2007; 10: 1340-1353.
15. Kant KA and Graubard BI. Secular trends in patterns of self reported food consumption of adult Americans: NHANES 1971-1975 to NHANES 1999-2002. *Am J Clin Nutr.* 2006; 84:1215-1223.
16. Wu SJ, Pan WH, Ye NH, Chang HY. Trends in nutrient and dietary intake among adults and the elderly: from NAHSIT 1993- 1996 to 2005 – 2008.
17. Perrin AE, Simon C, Hedeloin G, Arveiler D, Schlienger JL. Ten-year trends of dietary intake in a middle-aged french population: relationship with educational level. *Eur J Nutr.* 2002;56:393-401.
18. Flood VM, Burlutsky G, Webb KL, Wang JJ, Smith WT, Mitchell P. Food and nutrient consumption trends in older Australians: a 10-year cohort study. *Eur J Clin Nutr.* 2010; 64:603-13.
19. Al-Tahan J, González-Gross M, Pietrzik K. B-vitamin status and intake in European adolescents. A review of the literature. *Nutr Hosp.* 2006;21:452-65.
20. Pan WH, Wu HJ, Yeh CJ, Chuang SY, Chang HY, Yeh NH, Hsieh YT. Diet and health trends in Taiwan: comparison of two nutrition and health survey from 1993-1996 and 2005-2008. *Asia Pac J Clin Nutr.* 2011; 20:238-50.
21. Fulgoni V, Nicholls J, Reed A, Buckley R, Kafer K, Huth P, DiRienzo D, Miller GD. Dairy consumption and related nutrient intake in African-American adults and children in the United States: continuing survey of food intake by individuals 1994-1996, 1998, and the National Health and Nutrition Examination Survey 1999-2000. *J Am Diet Assoc.* 2007; 107:256-64.
22. Tabacchi G, Wijnhoven TM, Branca F, Román-Viñas B, Ribas-Barba L, Ngo J, García-Alvarez A, Serra-Majem L. How is the adequacy of micronutrient intake assessed across Europe? A systematic literature review. *Brit J Nutr.* 2009; 2: 29-36.
23. McNulty H and Scott JM. Intake and status of folate and related B-vitamins: considerations and challenges in achieving optimal status. *Brit J Nutr.* 1999; 3:48-54.
24. Cashman KD, Flynn A. Optimal nutrition: calcium, magnesium and phosphorus. *Proc Nutr Soc.* 1999; 58:477-87.

25. Tur JA, Serra-Majem L, Romaguera D, Pons A. Does the diet of Balearic population, a Mediterranean type diet, still provide adequate antioxidant nutrient intakes? *Eur J Nutr.* 2005; 44:204-213.
26. Pinheiro MM, Cicconeli RM, Chaves GV, Aquino L, Juzwiak CR, Genaro P de S, Ferraz MB. Antioxidant intake among Brazilian adults—the Brazilian Osteoporosis Study (BRAZOS): a cross-sectional study. *J Nutr.* 2011; 25:10-39.
27. Agudo A, Cabrera L, Amiano P, Barricarte A, Berenguer T, Chirlaque MD, Dorronsor M, Jakzyn P, Larrañaga L, Martínez C, Navarro C, Quiróz JR. Fruit and vegetables intakes, dietary antioxidant nutrients, and total mortality in Spanish adults: findings from the Spanish cohort of the European Prospective Investigation into Cancer and Nutrition (EPIC-Spain). *Am J Clin Nutr.* 2007; 85: 1634-1642.
28. Toffanello ED, Inelmen EM, Minicuci N, Campigotto F, Sergi G, Coin A, Miotto F, Enzi G, Manzato E. Ten-year trends in vitamin intake in free-living healthy elderly people: the risk of subclinical malnutrition. *J Nutr Health Aging.* 2011; 15:99-103.
29. Ortega Anta RM, López Sobaler AM, Requejo Marcos AM, Carvajales PA. La composición de los alimentos: Herramientas básicas para la valoración nutricional. Universidad Complutense. Madrid, 2004.

Table 1 Trends of food patterns in the adult population of Balearic Island aged of 16 to 65 years (1999 - 2010) by gender.

Dietary characteristic	Gender	ENIB (1999 - 2000)	Recommended ranges	OBEX (2009 - 2010)
		Mean±SD (n=1455)	(WHO/FAO)	Mean±SD (n=1388)
% of energy from proteins	Men	17.94±5.94	10 - 15%	16.92±4.98*
	Women	17.87±5.22		17.38±5.33
% of energy from CHO	Men	41.73±9.40	55 - 75%	44.81±9.57***
	Women	42.95±9.52		43.41±9.74
% of energy from total fat	Men	38.45±8.64	15 - 30%	36.82±8.41**
	Women	38.62±8.47		38.35±8.95
% of energy from SFA	Men	13.18±4.04	?10%	12.17±3.92***
	Women	13.30±4.05		12.27±4.25***
% of energy from MUFA	Men	16.68±4.76	15 - 20%	16.48±5.01
	Women	16.71±4.76		17.26±5.32*
% of energy from PUFA	Men	4.81±2.41	6 - 10%	4.21±1.86***
	Women	4.69±2.29		4.44±1.81*
Cholesterol (mg/d)	Men	420.09±248.72	<300 mg/d	364.93±273.35***
	Women	324.04±203.75		321.99±203.66
Fruit and Vegetables (g/d)	Men	317.60±347.79	?400 g/d	387.91±267.46***
	Women	365.25±373.56		456.95±297.10***
Fibre (g/d)	Men	16.28±9.04	>25 g/d	18.19±8.79***
	Women	15.08±7.60		17.04±8.09***
Sodium (mg/d)	Men	2.33±1.47	<2 g/d	2.38±1.33
	Women	1.79±0.88		1.99±1.13***

ENIB (Nutrition survey of the Balearic Islands 1999 – 2000).

OBEX (Nutrition survey: Obesity and oxidative stress 2009 – 2010).

Differences between surveys were tested with ANCOVA and adjusted by age.

Significance: * p-value <0.05; **p-value <0.01; ***p-value <0.001. All p-values are corrected by sequential Bonferroni's test to control type-I error.

Table 2. Trends in nutrient consumption in men and women age 16 to 65 years of Balearic Island, from 1999 to 2010.

Nutrient	Gender	ENIB (1999 - 2000)				OBEX (2009 - 2010)			
		% of the sample with intake				% of the sample with intake			
		?RDI	<RDI	<2/3 RDI	<1/3 RDI	?RDI	<RDI	<2/3 RDI	<1/3 RDI
Magnesium (mg)	Men	14.4	85.6	4.7	52.5	13.2	86.8	3.9	49.3
	Women	13.5	86.5	3.7	51	16.3	83.7	2.6	40.7***
Iron (mg)	Men	63.1	36.9	2	11.1	72.5	27.5**	0.7	6.3**
	Women	21.7	78.3	4.8	45.1	40.9	59.1***	2.6*	27.3***
Phosphorus (mg)	Men	91.2	8.8	0.2	2.7	84.2	15.8**	0.2	3.4
	Women	86	14	0.1	3.6	83.3	16.7	0.2	4.1
Calcium (mg)	Men	22.7	77.3	11.1	40.4	26.1	73.9	14	46.5
	Women	11.6	88.4	13.7	60.3	11.7	88.3	12.4	58.6
Selenio (µg)	Men	89.1	10.9	1	3.5	85.1	14.9	1.6	6
	Women	90	10	1.8	5.7	89.9	10.1	1.1	5.7
Iodine (µg)	Men	11.7	88.3	18.3	68	30.9	69.1***	8.4***	39.1***
	Women	8.7	91.3	23.3	69.9	27.2	72.8***	7.0***	41.4***
Zinc (mg)	Men	22	78	6.6	44.9	21.9	78.1	4.2	44
	Women	19.1	80.9	7.4	42.2	27.2	72.8***	4.6*	35.5***
Retinol (µg)	Men	2.6	97.4	54.4	93	2.1	97.9	56.3	89.1*
	Women	3	97	52.4	88.8	3.3	96.7	52	89.1
Thiamine (mg)	Men	48	52	2.3	16.7	67.7	32.3***	1.8	11.2**
	Women	40.6	59.4	1.5	22.6	62.5	37.5***	0.4*	11.4***
Vitamin B12 (µg)	Men	83.4	16.6	2.3	7.7	83	17	2.8	8.1
	Women	74.8	25.2	3.6	13.5	76.1	23.9	4.4	12.5
Vitamin B6 (mg)	Men	58.7	41.3	1.5	15.2	67.2	32.8**	1.6	11.8
	Women	53.1	46.9	1.4	16.9	68.4	31.6***	0.5*	9.8***
Vitamin C (mg)	Men	66.7	33.3	8.1	23	69.6	30.4	7.4	20.7
	Women	66.4	33.6	5.5	20.3	74.3	25.7***	6.4	15.8**
Vitamin D (µg)	Men	9.7	90.3	57.5	69.1	17.3	82.7***	46.8***	58.3***
	Women	7.7	92.3	62.3	76.2	10.3	89.7*	57.5*	67.9***
Vitamin E (mg)	Men	35.9	64.1	8.8	37.6	29.5	70.5*	9.1	42.3
	Women	43	57	4.9	30.4	42.4	57.6	5.1	28.7
Niacin (mg)	Men	49.2	50.8	3.8	23.7	61.8	38.2***	3.2	17.2**
	Women	46.6	53.4	4.2	27.4	63.8	36.2***	1.6***	15.4***
Pantothenic acid (mg)	Men	59.6	40.4	1.4	13.3	50	50.0**	1.5	17.7
	Women	43.8	56.2	1.3	18.8	44.1	55.9	1.4	19.4
Folic acid (µg)	Men	17.4	82.6	14.1	54.5	23.9	76.1*	1.18	49.6
	Women	14.8	85.2	16	57.5	22.7	77.3***	10.5***	51.5**

ENIB (Nutrition survey of the Balearic Islands 1999 – 2000).

OBEX (Nutrition survey: Obesity and oxidative stress 2009 – 2010).

RDI Recommended Dietary Intake for the Spanish Population [Ortega Anta RM., et al. 2004]

Differences between surveys were tested by χ^2 -test.

Significance: * p-value <0.05; **p-value <0.01; ***p-value <0.001.

Table 3. Trends in nutrient consumption in the adult population of Balearic Island from 1999 to 2010 by age group.

Age groups	Survey	16 - 25 y				26 - 45 y				46 - 65 y			
		% of the sample with intake				% of the sample with intake				% of the sample with intake			
		?RDI	<RDI	<2/3 RDI	<1/3 RDI	?RDI	<RDI	<2/3 RDI	<1/3 RDI	?RDI	<RDI	<2/3 RDI	<1/3 RDI
Magnesium (mg)	ENIB	15.5	84.5	5.2	52	13.5	86.5	4.1	52.1	12.1	87.9	1.9	49.7
	OBEX	12.1	87.9	5.6	52.4	16.8	83.2	1.3**	38.9***	18.1	81.9*	1.3	36.6**
Iron (mg)	ENIB	26.2	73.8	5.2	42.7	25.9	74.1	5.1	45.3	43.7	56.3	1.8	79.1
	OBEX	49.7***	50.3***	2.0**	19.6***	52.8***	47.2***	1.8**	19.5***	68.3***	31.7***	1.3	86.3*
Phosphorus (mg)	ENIB	80.7	19.3	0.6	7	89.9	10.1	0	1.9	90.1	9.9	0	2.1
	OBEX	70.1***	29.9***	0.3	8	94.6**	5.4**	0.2	0.7	92.5	7.5	0	0.9
Calcium (mg)	ENIB	16.5	83.5	13.1	52.4	15.4	84.6	13.4	55.1	10.3	89.7	12.7	58.7
	OBEX	15.1	84.9	17.2	59.7*	21.5**	78.5**	10.7	47**	15	85	8.4	53.7
Selenio (µg)	ENIB	90.1	9.9	1	4.8	89.7	10.3	1.7	5.4	89.7	10.3	2.1	5.3
	OBEX	89	11	1.4	5	87.1	12.9	0.9	6.9	86.3	13.7	1.9	5.2
Iodine (µg)	ENIB	12.7	87.3	23.8	66.1	7.2	92.8	21.1	70.1	9.2	90.8	21.8	71.9
	OBEX	27.6***	72.4***	10.2***	44.6***	28.6***	71.4***	5.6***	37.4***	32.2***	67.8***	5.7***	37.0***
Zinc (mg)	ENIB	27	73	5.6	38.1	18.5	81.5	7.9	45.9	14.4	85.6	7.8	48.3
	OBEX	29.9	70.1	5.4	36.7	21.5*	78.5*	3.4**	38.3	20.7*	79.3*	4.4	46.7
Retinol (µg)	ENIB	2.7	97.3	51.7	90.6	3	97	50.5	88.7	3.2	96.8	57.1	90.3
	OBEX	3.4	96.6	52.2	86.9	2.9	97.1	51.2	89.5	0.9	99.1	64.3	93.8
Thiamine (mg)	ENIB	49	51	2.4	19.2	41.9	58.1	1.6	23.4	36.5	63.5	1	20.3
	OBEX	66.0***	34.0***	1.4	12.8**	64.0***	36.0***	0.7	11.4***	63.0***	37.0***	0.4	7.5***
Vitamin B12 (µg)	ENIB	77.9	22.1	3.2	13	76.3	23.7	2.8	11.3	76.5	23.5	4.1	12.5
	OBEX	75.7	24.3	4.4	13.1	83.2**	16.8**	2.7	8.3	77.1	22.9	4.4	10.1
Vitamin B6 (mg)	ENIB	58.7	41.3	1.6	16.1	55.5	44.5	1.3	14.6	48.9	51.1	1.4	19.5
	OBEX	67.0**	33.0**	1.2	10.9*	69.8***	30.2***	0.5	9.6**	65.6***	34.4***	1.3	12.3*
Vitamin C (mg)	ENIB	61.7	38.3	8.5	25.4	65.1	34.9	6	21.3	72.9	27.1	3.9	16.2
	OBEX	66.3	33.7	8.8	21.3	74.5***	25.5***	6.1	17.5	82.8**	17.2**	3.1	9.7*
Vitamin D (µg)	ENIB	6.7	93.3	60.1	73.3	8.4	91.6	58.4	72.4	9.2	90.8	66.1	78
	OBEX	13.3***	86.7***	53.6*	63.4***	13.4**	86.6**	49.7**	61.7***	12.3	87.7	59.9	70.5*
Vitamin E (mg)	ENIB	41.5	58.5	6.3	30.8	40	60	6.3	34.6	42.9	57.1	4.9	30
	OBEX	29.6***	70.4***	9.7*	43.5***	42	58	4.2	27.3**	44.1	55.9	5.7	27.8
Niacin (mg)	ENIB	50.4	49.6	3.8	25.6	46.2	53.8	4.1	29.1	45.4	54.6	4.3	24
	OBEX	61.4***	38.6***	3.7	19.2*	64.2***	35.8***	1.1**	13.4***	63.9***	36.1***	1.3*	15.0**
Pantothenic acid (mg)	ENIB	48.2	51.8	1.6	18.5	47.1	52.9	1.5	18.8	47.4	52.6	1.2	16.8
	OBEX	43.7	56.3	2.2	22.8	46.7	53.3	1.1	16.1	53.7	46.3	0.4	16.3
Folic acid (µg)	ENIB	12.7	87.3	20.8	64.9	14.4	85.6	16.2	57.6	19.5	80.5	9.7	47.8
	OBEX	18.2*	81.8*	14.5**	58.2*	26.2***	73.8***	9.4***	47.4***	28.6**	71.4**	6.2	39.6*

ENIB (Nutrition survey of the Balearic Islands 1999 – 2000).

OBEX (Nutrition survey: Obesity and oxidative stress 2009 – 2010).

RDI Recommended Dietary Intake for the Spanish Population [Ortega Anta RM, et al. 2004]

Differences between surveys were tested by χ^2 -test.

Significance: * p-value <0.05; **p-value <0.01; ***p-value <0.001.

Manuscript VI

Trends of eating habits in the adult population of Balearics Islands, Spain (1999 – 2010).

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Trends of eating habits in the adult population of Balearics Islands, Spain (1999 – 2010).

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Abstract

Aims: Evaluation of trends of eating habits in the adult population of Balearics Islands, Spain (1999 – 2010). **Methods:** The nutritional data from the present study are derived from the last two Balearic Island Nutritional Survey carried out in 1999 – 2000 (ENIB) and 2009 – 2010 (OBEX). Samples were selected by considering the proportion of the number inhabitants and the specific weight of each municipality in the sample and the sample population was derived from residents aged 16-65 years registered in the official population census of the Balearic Island. The theoretical sample size in both surveys was 3142 individuals and the final sample was 2843 (90% participation). Dietary habits were assessed by food frequency questionnaires and global questionnaire incorporating questions related to socio-economic status, education level and life-style factors were utilized. Prevalence of overweight and obesity was calculated according body mass index (BMI). **Results:** The mean age of the subjects was 37 years in ENIB 1999-2000 and 31 years in OBEX 2009 – 2010. In the last ten years the educational level showed an increased 10.2% ($p < 0.001$), the unemployment was increased 3.5%, students 6.2%, work and study the increased was from 5.8%. The seasonal work decreased 7.1% ($p < 0.001$). The number of meals is associated with nutritional status of adult population, people with overweight and obese, showed a frequency of meals under three per day, while the people normal-weight the frequency of meals was of 4 to 5 or more times. The diet is characterized by a increased in the consumption of animal product (meat, fish and eggs), a low percentage of population meets with recommendations. The high intake of meat, sugar and cakes and soft drinks; and the low intake of vegetables, fruits, nuts and pulses are aspect of unhealthy food habits, but also a poor adherence to the Mediterranean diet. **Conclusion:** In this study we have demonstrated that adult population of Balearics Islands, show changes important in eating habits mainly in food naturals intake characteristic of Mediterranean diet.

Key Words: Nutrition Survey, Eating patterns, Food consumption, Balearics Islands.

Introduction

The main causes of mortality in developed countries are closely related to diet, alcohol consumption, smoking and low levels of physical activity. Interventions in public health aim to reduce the average health risk for the general population as well as to achieve an optimal state of health and wellbeing [Ribas-Barba L *et al.* 2007]. The rapid shift in the stage of nutrition towards a pattern of degenerative disease is accelerating in the developing world. These rapid changes in the levels and compositions of dietary and activity/inactivity patterns in transitional societies are related to a number of socioeconomic and demographic changes [Popkin BM. 2001; Moreno LA *et al.* 2002; Popkin BM. 2006]. While the control and prevention of under-nutrition is an unfinished work, nutrition-related chronic diseases are increasing leading to disabilities and death globally and in developing countries, including Mediterranean countries, what is called nutrition transition [Belahsen R & Rquibi M. 2006; Barbagallo CM *et al.* 2002; Bas M *et al.* 2005]. For this reason, in 1999-2000 was carried the first survey of nutrition in adults population of Balearic Island, Spain (ENIB 1999-2000), to have an initial baseline survey so as to assesses the nutritional status of the population and thus identify and quantify the magnitude of the major nutrition related problems, as well as to ascertain the causes, at risk groups, related life style determinants. After ten years, has been repeated a similar study (OBEX 2009-2010) [Tur JA *et al.* 2004; Tur JA *et al.* 2004]. The aim of repeating the survey in the same population is to evaluate the trends in food consumption, eating habits and the prevalence of health-risk factors as sedentary lifestyles, smoking, alcohol intake, perception of body image and nutritional assessment through anthropometric measures; in this way problems can be prioritized, solutions sought [Ribas-Barba L *et al.* 2007; Akman M *et al.* 2010; Mishra G *et al.* 2002]. For this reason the aim of our study was the evaluation of trends of eating habits in the adult population of Balearics Islands, Spain (1999 – 2010).

Methods

Study design

The nutritional data from the present study are derived from the last two Balearic Island Nutritional Survey carried out in 1999 – 2000 (ENIB) and 2009 – 2010 (OBEX).

Sample

Samples were selected by considering the proportion of the number inhabitants and the specific weight of each municipality in the sample and the sample population was derived from residents aged 16-65 years registered in the official population census of the Balearic Island. The theoretical sample size in both surveys was 3142 individuals and the final sample was 2843 (90% participation), pooled from the two survey (867 men and 1976 women): 1455 belonged to ENIB 1999 – 2000 (286 men and 1169 women) and 1388 belonged to OBEX 2009 – 2010 (581 men and 807 women). 10% of the sample was under-report.

Questionnaires

Both in survey ENIB (1999 – 2000) and OBEX (2009- 2010) was designed as a cross-sectional survey. Dietary questionnaires and global questionnaire incorporating questions related to socio-economic status, education level and life-style factors were utilized. A semiquantitative food frequency questionnaire was utilized (FFQ). FFQ was previously validated [Martin-Moreno JM *et al.* 1993] and applied to other studies and surveys over the Spanish population [Tur JA *et al.* 2004; Tur JA. 2004; Serra-Majem L *et al.* 1994; Bondia-Pons I *et al.* 2007]. The FFQ, which asked the subject to recall average use over the past year, consisted of 145 items (118 of the original validated FFQ plus the most characteristic Balearic Islands foods in order to make easy the interviewee answer), and arranged by food type and meal pattern. Frequency of food consumption was based on times that food items were consumed (per day, week or month). Consumption <1/month was considered no consumption. Daily consumption (g) was determined by dividing the reported amount of the intake by the frequency (d). The period of consumption of seasonal items was also considered. Edible fractions of foods were recorded in the database [Martin-Moreno JM. *et al.* 1993; Serra-Majem L *et al.* 1994; Bondia-Pons I *et al.* 2007].

Prevalence of overweight and obesity was calculated according body mass index (BMI, weight in kg/height² in meters). Height was determined using a mobile anthropometry (KaWe, France) to the nearest millimeter, with the subject's head in the Frankfurt plane. Body weight was determined to the nearest 100 g using a digital scale (Tefal, SC 9210, France). The subjects were weighed in bare feet and light underwear, which was accounted for by subtracting 200–400 g from the measured weight.

The questionnaires were administered in the subject's home, area work, health centre or other public site. To avoid bias brought on by day-to-day intake variability, the

questionnaires were administered homogeneously from Monday to Sunday. In order to estimated volumes and portion sizes, the household measures found in the subject's own homes were used.

Statistics

Analyses were performed with SPSS version 19.0. Descriptive statistics were calculated, Differences between surveys were tested by χ^2 -test. Sequential Bonferroni's test was applied to control type-I error [Holm S. 1979]. The level of significance was established for P values <0.05 .

Ethics

The present study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects were approved by the Balearic Islands Ethics Committee. Written informed consent was obtained from all subjects and their parents or legal tutors.

Results

Table 1 shows the sample distributions of both surveys by gender and age group, which were similar to one another as well as being representative of the Balearic Island population in the years when the survey were carried out (1999 – 2000 and 2009 – 2010). The mean age of the subjects was 37 years in ENIB 1999-2000 and 31 years in OBEX 2009 – 2010. The educational and employment status the sample in both studies is show in the figure 1 and 2. In the last ten years the educational level showed an increased 10.2% ($p < 0.001$), the unemployment was increased 3.5%, students 6.2%, work and study the increased was from 5.8%. The seasonal work decreased 7.1% ($p < 0.001$).

Table 2 Show the background variables and eating habits of the two surveys. The difference between the two surveys ENIB 1999 – 2000 and OBEX 2009 – 2010 and statistical significance are also presented. A significant increased was observed in the percentage of population with 1 or 2 meals per day from 2.4% in ENIB 1999 - 2000 to 5.6% in OBEX 2009 – 2010. A slight decreased was observed for population with 3 meals per day from 24.2% in ENIB to 23.0% in OBEX. A greater proportion of the population was shown to have 4 – 5 or more meals per day; however, the percentage in OBEX was low from 73.2% in ENIB to 61.6% in OBEX. The place of meals also show

increased in OBEX, the percentage of the population that breakfast and lunch did at home was from 94.3% and 83.5% respectively. The place of meals also show increased in OBEX, the percentage of the population that breakfast and lunch did at home was from 94.3% and 83.5% respectively, while the population that dinner in home was 79.2%. The weekend, over 60% of the population, breakfast, lunch and dinner at home ($p < 0.001$); the breakfast not showed difference significant in both studies. Respect to choice of oils we observed a decreased in last years, however, the olive oil was more used to fry and cook 44.1% and 56.8% respectively; and 60.5% used virgin olive oil to dress. According to BMI an decreased was observed in percentage of population with overweight from 30.2% in ENIB to 28.5% in OBEX, similar behaviour was observed in obese from 12.1% in ENIB to 11.5% in OBEX ($p < 0.001$). In both studies 27.1% in ENIB and 29.4% in OBEX reported having been on a diet in the last 12 months, the main reason was to be considered overweight 30.2% in ENIB and 28.5% in OBEX ($p < 0.001$). The percentage of the population with current dietary treatment showed a significant increase from 9.4% in ENIB to 13.3% in OBEX ($p < 0.001$), currently only 34.3% are considered obese. Respect to smoking we observed a slight decrease in the proportion of smokers, from 26.5% in ENIB to 21.4% in OBEX ($p < 0.001$). Regarding the perception of alcohol intake the percentage of the population considered abstemious showed a slight increase from 31.5% in ENIB to 35.2% in OBEX; 26.9% in ENIB and 38.6 in OBEX their perceptions was a sporadic drinker.

Table 3 Show the percentage of population that meets the recommendations for food group in both survey. A low percentage of the population showed an adequate intake of recommended daily servings (RDS) for food group meat, fish and eggs, not observed difference significant in both studies. In the last ten years under 30% of population has shown an intake below the RDI in the food group of olive oil 24.4%, other oils and fats 3.9%, vegetables 14.2%, fruit 25.4%, nuts, 9.4%, pulses 29.5%, potatoes, cereal and bread 26.1% ($p < 0.001$), while the percentage of compliers was higher in food groups of sugar and cakes 81.9%, soft drinks 81.6% and alcohol 83.5% ($p < 0.001$).

Discussion

Our results showed that, seasonal work decreased in OBEX principally in the population with low level educational, we observed that the percentage of population with permanente work are associated with educational status high, while the percentage

of unemployment was associated with low and medium educational status. In the last years was observed a increased rate unemployment, students and people that working and studding.

In our studying we observed that the number of meals is associated with nutritional status of adult population, people with overweight and obese, showed a frequency of meals under three per day, while the people normal weight the frequency of meals was of 4 to 5 or more times. These results were in concordance with previous studies that reported a significant reduction of obesity risk with increasing number of meals; this association was also observed in children and adolescents [Koletzko B & Toschke AM. 2010; Toschke AM *et al.* 2009; Grujić V *et al.* 2010]. Over 60% of the population of Balearic Island, home made meals including the weekend well. The traditional Mediterranean diet patterns is characterized by the daily use of olive oil, in our study was observed a slight decreased in olive oil intake, but continuing remains principal ingredient for fry, cook and drees salad. The role of a Mediterranean dietary pattern on all-cause and cause-specific mortality was assessed within the Spanish adult population. The present results show that high adherence to the MD was related to a significant 21% reduction in all-cause mortality and a 34% reduction in CVD. The beneficial effect of the MD on mortality seemed to be predominantly due to the abundance of olive oil and moderate alcohol intake within this dietary pattern [Buckland G *et al.* 2011; Sofi F *et al.* 2008; Karamanos B *et al.* 2002].

Respect to overweight and obesity, we observed a slight decrease in OBEX, using BMI 40% of the population have overweight or obesity, factors such as nutrition transition, inactivity, urbanization, marital status, a shorter duration of breastfeeding, frequent snacking, skipping breakfast, a high intake of sugary beverages, an increase in the incidence of eating outside the home, long periods of time spent viewing television, massive marketing promotion of high fat foods, stunting, perceived body image and cultural elements can be associated [Musaiger AO. 2011; McLaren L. 2007; Szajewska H & Ruszczyński M. 2010], In OBEX the percentage of population with dietary treatment in last 12 months was high and the principal motive was as overweight, this perception can be associated to eating behaviours, social support, perceived stressors and quality of life [EI-Ansari W *et al.* 2010]. Respect to smoking habits, during the last ten years the prevalence of regulars smokers in Balearics Islands populations decreased

slight, age, educational level showed a relationship with the smoking habits among men and women mainly age group 26 to 45 years, these results were in concordance with the previous literature [Buivydaite K *et al.* 2003; Divisón Garrote JA *et al.* 2011]. The perception respect to alcohol intake in the people showed a increased in percentage of people that be considered abstemious and sporadic drinker, while people who drink do so primarily at meals and at night. In the context of Mediterranean diet, the average current consumption was adequate to the recommendations [Tur JA *et al.* 2004; Serra-Majem L *et al.* 2001], showing a moderate alcohol consumption of 0.25 servings per day (data not showed), many epidemiological studies have shown that moderate alcohol intake, from 10 to 30 g of ethanol a day, decreases cardiovascular mortality from atherosclerotic ischemic stroke as compared to non-drinkers, therefore, is to recognize the healthy properties of polyphenols and other phytochemicals contained in wine [Tur JA *et al.* 2004; Serra-Majem L *et al.* 2001; Rayo Llerena I & Marín Huerta E. 1998; Nicoll R & Henein MY. 2011].

The food consumption, was compared with recommended daily serving (RDI) for the Spanish population, in our study can be showed the percentage of population that meets recommendations in both studies, the diet is characterized by a increased in the consumption of animal product (meat, fish and eggs), a low percentage of population meets with recommendations. The high intake of meat, sugar and cakes and soft drinks; and the low intake of vegetables, fruits, nuts and pulses are aspect of unhealthy food habits, but also a poor adherence to the Mediterranean diet [Tur JA *et al.* 2004; Ribas-Barba L *et al.* 2007; Rumm-Kreuter D. 2001]. Therefore, promoting higher consumption of natural foods as fruits, vegetables, nuts, pulses and olive oil in the general population in the Mediterranean countries, could slow the trend of abandonment of the Mediterranean diet [Rayo Llerena I & Marín Huerta E. 1998; Nicoll R & Henein MY. 2011].

Conclusions

In this study we have demonstrated that adult population of Balearics Islands, show changes important in eating habits mainly in food naturals intake characteristic of Mediterranean diet, it would be convenient to developed nutrition education programs in all population levels, with the aim to make know the beneficial effects of the Mediterranean diet, not only in cardiovascular diseases but also for diabetes, obesity, arthritis and cancer.

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References

1. Ribas-Barba L, Serra-Majem L, Salvador G, Castell C, Cabezas C, Salleras L, Plasencia A: Trends in dietary habits and food consumption in Catalonia, Spain (1992–2003). *Public Health Nutr* 2007; 10:1340-1353.
2. Popkin BM. The nutrition transition and obesity in the developing world. *J Nutr*. 2001; 131:871S-873S.
3. Moreno LA, Serría A, Popkin BM. The Nutrition transition in Spain: a European Mediterranean country. *Eur J Clin. Nutr.* 2002; 56:992-1003.
4. Popkin BM. Global nutrition dynamics: the world is shifting rapidly toward a diet linked with noncommunicable diseases. *Am J Clin Nutr.* 2006; 84: 289-98.
5. Belahsen R, Rquibi M. Population health and Mediterranean diet in southern Mediterranean countries. *Public Health Nutr.* 2006; 9:1130-5.
6. Barbagallo CM, Cavera G, Sapienza M, Noto D, Cafalú AB, Polizzi F, Onorato F, Rini G, Di Fede G, Pagano M, Montalto G, Rizzo M, Descovich G, Notarbartolo A, Averna MR. Nutritional characteristics of a rural Southern Italy population: the Ventimiglia di Sicilia Project. *J Am Coll Nutr.* 2002; 21:523-9.

7. Bas M, Altan T, Dincer D, Aran E, Kaya HG, Yüksek O. Determination of dietary habits as a risk factor of cardiovascular heart disease in Turkish adolescents. *Eur J Nutr.* 2005; 44:174-82.
8. Tur JA, Romaguera D & Pons A: Adherence to the Mediterranean dietary pattern among the population of the Balearic Islands. *Brit J Nutr.* 2004; 92:341-346.
9. Tur JA, Romaguera D & Pons A: Food consumption patterns in a Mediterranean Region: Does the Mediterranean diet still exist? *Ann Nutr Metabol.* 2004; 48:193-201.
10. Akman M, Akan H, Izbirak G, Tanriöver Ö, Tilev SM, Yildiz A, Tektas S, Vitrinel A, Hayran O. Eating Patterns of Turkish adolescents: a cross-sectional survey. *J Nutr.* 2010;19;9:67.
11. Mishra G, Ball K, Arbuckle J, Craeford D. Dietary patterns of Australian adults and their association with socioeconomic status: results from the 1995 National Nutrition Survey. *Eur J Nutr.* 2002; 56: 687-93.
12. Martin-Moreno JM, Boyle P, Gorgojo L, et al. Development and validation of a food frequency questionnaire in Spain. *Int J Epidemiol.* 1993; 22:512-519.
13. Serra-Majem L, Morales D, Domingo C, Caubet E, Ribas L & Nogués RM: Comparison of two dietary methods: 24-hour recall and semiquantitative food frequency questionnaire (in Spanish). *Med Clin (Barc)* 1994; 103:652-656.
14. Bondia-Pons I, Serra-Majem L, Castellote AI, López-Sabater MC: Identification of foods contributing to the dietary lipid profile of a Mediterranean population. *Brit J Nutr.* 2007; 98; 583-592.

15. Holm S: A simple sequentially rejective multiple test procedure. *Scand J Stat* 1979; 4: 1403-1408.
16. Koletzko B, Toschke AM. Meal patterns and frequencies: do they affect body weight in children and adolescents? *Crit Rev Food Sci Nutr*. 2010;50; 100-5.
17. Toscke AM, Thorsteinsdottir KH, von Kries R; GME Study Group. Meal frequency, breakfast consumption and childhood obesity. *Int J Pediatr Obes*. 2009; 4:242-8.
18. Grujic V, Dragnic N, Radic I, Harhaji S, Susnjevic S. Overweight and obesity among adults in Serbia: results from the National Health Survey. *Eat Weight Disord*. 2010; 15:e34-42.
19. Al-Rethaiaa AS, Fahmy AE, Al-Shwaiyat NM. Obesity and eating habits among college students in Saudi Arabia: a cross sectional study. *Nutr J*. 2010; 19:9-39.
20. Buckland G, Agudo A, Travier N, María Huerta J, Cirera L, Tormo MJ, Navarro C, Dolores Chirlaque M, Moreno-Iribas C, Ardanaz E, Barricarte A, Etxeberria J, Marin P, Ramón Quirós J, Redondo ML, Larrañaga N, Amiano P, Dorronsoro M, Arriola L, Basterretxea M, Sanchez MJ, Molina E, González CA. Adherence to the Mediterranean diet reduces mortality in the Spanish cohorte of the European Prospective Investigation into Cancer and Nutrition (EPIC-Spain). *Br J Nutr*. 2011; 17:1-11.
21. Sofi F, Cesari F, Abbate R, Gensini GF, Casini A. Adherence to Mediterranean diet and Elath status: meta analysis. *BMJ*. 2008; 11: 337-1344.
22. Karamanos B, Thanopoulou A, Angelico F, Assaad-Khalil S, Barbato A, Del Ben M, Dimitrijevic-Sreckovic V, Djordjevic P, Galloti C, Katsilambros N, Migdalis I, Mrabet M, Petkova M, Roussi D, Tenconi MT. Nutritional habits in the Mediterranean Basin. The macronutrient composition of diet and its relation

- with the traditional Mediterranean diet. Multi-centre study of the Mediterranean Group for the Study of Diabetes (MGSD). *Eur J Clin Nutr.* 2002; 56: 983-91.
23. Musaiger O. Overweight and obesity in eastern Mediterranean region: prevalence and possible causes. *J Obes.* 2011; 2011:407237.
 24. McLaren L. Socioeconomic status and obesity. *Epidemiol Rev.* 2007; 29: 29-48.
 25. Szajewska H, Ruszczyński M. Systematic review demonstrating that breakfast consumption influences body weight outcomes in children and adolescents in Europe. *Crit Rev. Food Sci. Nutr.* 2010; 50: 113-9.
 26. El-Ansari W, Clauseen SV, Mabhala A, Stock C. How do I look? Body image perceptions among university students from England and Denmark. *Int J Environ Res Public Health* 2010; 7:583-95.
 27. Buivydaite K, Domarkiene S, Reklaitiene R, Tamosiūnas A. The prevalence and trends of the smoking habits among middle aged Kaunas population during 20 years and their relation with sociodemographic status. *Medicina Kaunas* 2003; 39: 999-1006.
 28. Divisón Garrote JA, Massó Orozco J, Carrión Valero L, López Abril J, Carbayo Herencia JA, Artigao Rodenas LM, Gil Guillén V; Grupo de Enfermedades Vasculares de Albacete (GEVA). Trends in prevalence of risk factors and global cardiovascular risk in general population of Albacete, Spain (1992 – 94 a 2004 – 06). *Rev Esp Salud Pública* 2011; 85: 275-84.
 29. Serra-Majem LI, Aranceta J: Nutritional objectives for the Spanish population. Consensus from the Spanish Society of Community Nutrition. *Public Health Nutr* 2001;4:1409–1413.

30. Tur JA, Llado M, Alberti RC, Pons A: Changes on nutrient and food intakes in Mallorca throughout the 20th century (in Spanish). *Rev Esp Nutr Comunitaria* 2004;10:6-16.
31. Rayo Llerena I, Marín Huerta E. Wine and heart. *Rev. Esp. Cardiol.* 1998; 51: 435-49.
32. Nicoll R, Henein MY. Alcohol and heart. *Alcoholic Clin Exp Res.* 2011; 35: 1737-8.
33. Rumm-Kreuter D: Comparison of the eating and cooking habits of northern Europe and the Mediterranean countries in the past, present and future. *Int J Vitam Nutr Res.* 2001; 71:141-148.
34. Aranceta J, Serra-Majem L: Dietary guidelines for the Spanish population. *Public Health Nutr* 2001; 4:1403-1408.
35. Ortega Anta RM, López Sobaler AM, Requejo Marcos AM, Carvajales PA. La composición de los alimentos: Herramientas básicas para la valoración nutricional. Universidad Complutense. Madrid, 2004.

Table 1. Sample distribution by sex and age group in both surveys.

Gender	Age group (years)	Sample ENIB (1999-2000)		Sample OBEX (2009-2010)	
		n	%	n	%
Men					
	16 - 25	126	44	306	52.7
	26 - 45	103	36	201	34.6
	46 - 65	57	20	74	12.7
	Total	286	100	581	100
Women					
	16 - 25	307	26.3	293	36.3
	26 - 45	480	41	360	44.6
	46 - 65	382	32.7	154	19.1
	Total	1169	100	807	100
Total					
	16 - 25	433	29.8	599	43.2
	26 - 45	583	40	561	40.4
	46 - 65	439	30.2	228	16.4
	Total	1455	100	1388	100

ENIB (Nutrition survey of the Balearic Islands 1999 - 2000)

OBEX (Nutrition survey: Obesity and oxidative stress 2009 - 2010)

Table 2. Eating patterns of the participants in both surveys.

		ENIB (1999-2000)	OBEX (2009-2010)	
		%	%	
Meals per day	1-2	2.4	5.6	
	3	24.2	23	
	4 - 5 or more	73.2	61.6	
Meal times	Breakfast	24.5	77.9	
	Midmorning	56.2	62.9	
	Lunch	98.7	96.1	
	basket lunch	42.2	38.7	
	Dinner	96.7	93	
	After dinner	6.5	8.8	
	Between meals	22.8	16.9	
Place of meals	Breakfast	Home	82.6	94.3
		Outside home	17.4	5.7
	Lunch	Home	76.4	83.5
		Outside home	23.6	16.5
	Dinner	Home	88.4	79.2
		Outside home	11.6	20.8
Weekend	Breakfast	Home	88.7	88.5 (NS)
		Outside home	11.3	11.5
	Lunch	Home	72.1	79.2
		Outside home	27.9	20.8
	Dinner	Home	71.8	63.7
		Outside home	28.2	36.3
Choice of oils	Fry	Olive oil	60.1	44.1
		Sunflower	26.5	33.6
		Vurgini olive oil	11.7	21.3
	Cook	Olive oil	72.1	56.8
		Vurgini olive oil	14.7	30.6
		Sunflower	12	8.4
	Dress	Vurgini olive oil	38	60.5
		Olive oil	59.3	36.1
		Sunflower	2	2.1
Diet last 12 months	Si	27.1	29.4	
	No	72.9	70.6	
Motive	Disease	8.2	7.8	
	Overweight	15.4	49.5	
	other reasons	4.1	35.8	
Current diet	Si	9.4	13.3	
	No	90.6	86.7	
Considered obese	Si	39.3	34.3	
	No	60.7	65.7	
Smoke	Yes, regularly	26.5	21.4	
	No	70.7	61.9	
	Occasionally, <1 cigarette/day	2.9	3.5	
Perception alcohol intake	Abstemious	31.5	35.2	
	Sporadic drinker	29.6	38.6	
	weekend drinking	19.9	18.1	
	Daily	19	8.1	
	Alcoholic	-----	-----	

ENIB (Nutrition survey of the Balearic Island 1999 - 2000)

OBEX (Nutrition survey: Obesity and oxidative stress 2009 - 2010)

Differences between surveys were tested by χ^2 -test. All variables are statistically significant except these identified as (NS) = Non-significant

Table 3. Percentage of population that meets the recommendations for food group in both surveys (1999 - 2010).

Food Groups	ENIB (1999-2000)	RDS	OBEX (2009-2010)
	%		%
Meat, fish & eggs	1.3	2	1.0 (NS)
Milk & dairy products	49.6	2 to 4	47.2
Olive oil	11.5	3 to 5	20.4
Other oils & fats	18.7	Occ.	3.9
Vegetables	85.3	>=2	14.2
Fruit	36.3	>=3	25.4
Nuts	1.1	0.14	9.4
Pulses	14.5	0.43	29.5
Potatoes, cereals & bread	17.6	4 to 6	26.1
Sugar & cakes	98.4	Occ.	81.9
Soft drinks	90.4	Occ.	81.6
Alcoholic drinks	86.7	Occ.	83.5

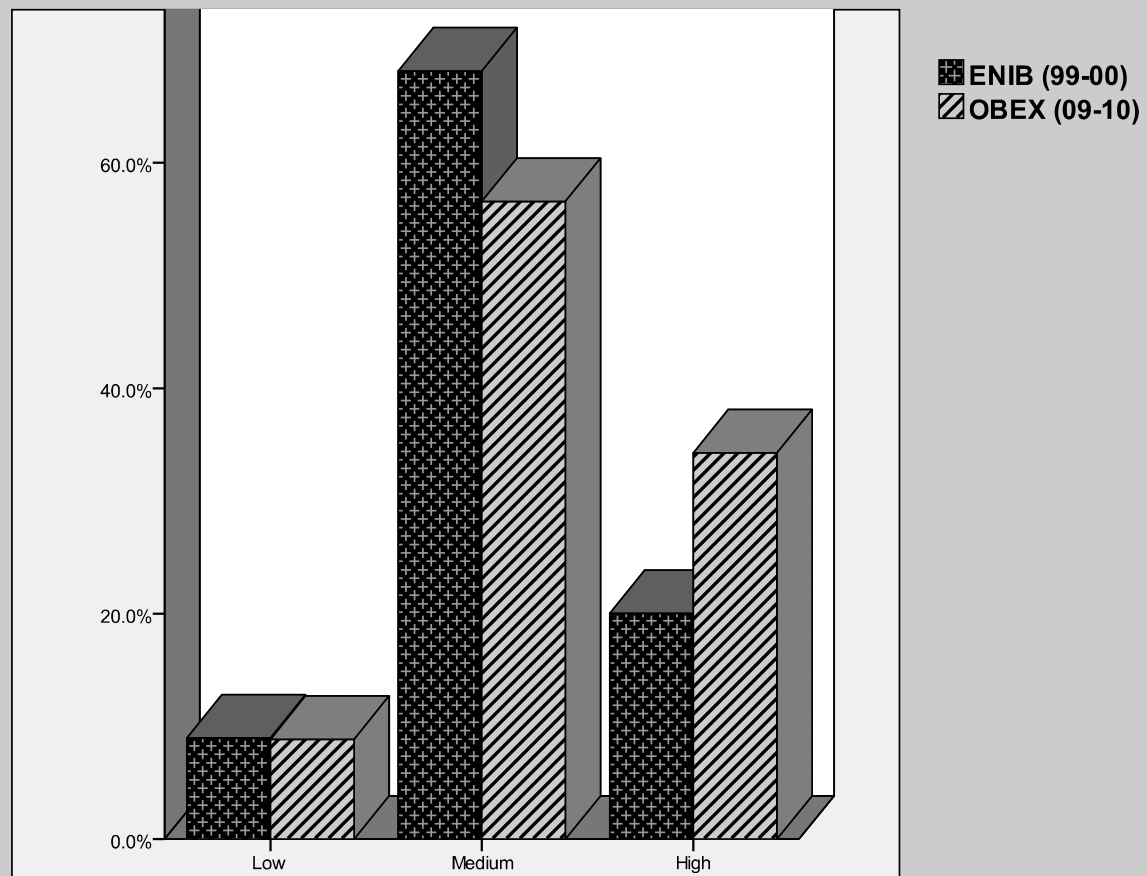
ENIB (Nutrition survey of the Balearic Island 1999 - 2000).

OBEX (Nutrition survey: Obesity and oxidative stress 2009 - 2010).

RDS = Recommended daily serving (frequency of consumption) [Ortega Anta RM., et al. 2004.] Occ. = Occasionally.

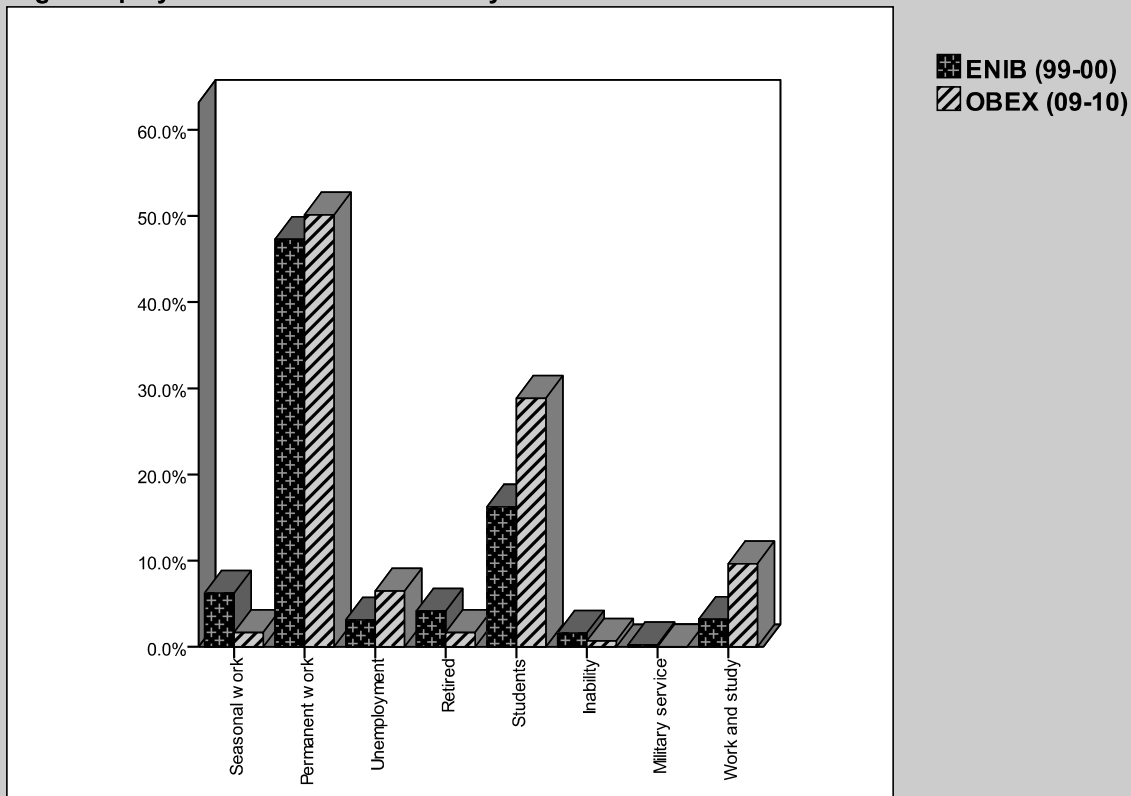
Differences between surveys were tested by χ^2 -test. All variables are statistically significant except these identified as (NS) = Non-significant.

Fig. 1 Respondent educational status in both survey.



Differences between surveys were tested Chi-square test. All variables are statistically significant.

Fig 2 Employment status in both surveys



Diferences between surveys were tested Chi-square test. All variables are statistically significant.

COMUNICACIONES

II World Congress of Public Health Nutrition - Porto, September 23 – 25, 2010.

Food consumption patterns in the Balearic Islands adult population (2009-2010).

Salas R, Zapata ME, Bibiloni MM, Coll JL, Pons A, Tur JA.

Trends in food consumption in the Balearic Islands, Spain (1999 – 2010).

Zapata ME, Salas R, Bibilono MM, Llull R, Pons A, Tur JA.

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NS

FOOD CONSUMPTION PATTERNS IN THE BALEARIC ISLANDS ADULT POPULATION (2009 – 2010).

[1] Salas, Rogelio; Research Group on Community Nutrition and Oxidative Stress; University of Balearic Islands, E-07122 Palma de Mallorca, Spain [2] Zapata, ME; Research Group on Community Nutrition and Oxidative Stress; University of Balearic Islands, E-07122 Palma de Mallorca, Spain [3] Bibiloni, MM; Research Group on Community Nutrition and Oxidative Stress; University of Balearic Islands, E-07122 Palma de Mallorca, Spain [4] Coll, JLI; Research Group on Community Nutrition and Oxidative Stress; University of Balearic Islands, E-07122 Palma de Mallorca, Spain [5] Pons, A; Research Group on Community Nutrition and Oxidative Stress; University of Balearic Islands, E-07122 Palma de Mallorca, Spain [6] Tur, JA; Research Group on Community Nutrition and Oxidative Stress; University of Balearic Islands, E-07122 Palma de Mallorca, Spain.

Objective: To assess the food consumption patterns in the Balearic Islands adult population. **Design:** A cross-sectional nutrition survey carried out on random sample of the Balearic Islands adult population (OBEX survey 2009-2010). Analysis is based on a total of 1064 individuals (455 men and 609 women), aged 16-65 years. **Method:** A validated semi-quantitative food frequency questionnaire was used to assess usual food and beverage consumption. Data were compared with the dietary guidelines for the Spanish population (Aranceta et al., Public Health Nutr 2001;4:1403-1408). **Results:** The Balearic population consumed less olive oil, vegetables, fruits and pulses, and more meat, fish and eggs, sugar and cakes, unhealthy snacks, fast foods, soft drinks and nuts than the recommendations. The consumption of milk and dairy products, salt and water is adequate to the recommended daily servings for the Spanish population, but the consumption of cereals, bread and potatoes were adequate for men but low for women. The consumption of cereals, bread, meat, fish and eggs, milk and dairy products, other oil and fats, sugar and cakes, and unhealthy snacks and fast food was inversely associated to the age, the opposite to vegetables, fruits and olive oil. **Conclusions:** To observe the recommendations for the Spanish population, the Balearic Islands adults must increase the consumption of fruits, vegetables, olive oil and pulses, and decrease other fats, sugar and cakes, meat and derivatives, unhealthy snacks, fast food, and soft drinks, mainly among the young adult population. (Program of Promotion of Biomedical Research and Health Sciences, Project 08/1259, and Predimed Network-RTIC RD06/0045/1004).

TRENDS IN FOOD CONSUMPTION IN THE BALEARIC ISLANDS, SPAIN (2009 – 2010).

[1] Zapata, ME; Research Group on Community Nutrition and Oxidative Stress; University of Balearic Islands, E-07122 Palma de Mallorca, Spain [2] Salas, Rogelio; Research Group on Community Nutrition and Oxidative Stress; University of Balearic Islands, E-07122 Palma de Mallorca, Spain [3] Bibiloni, MM; Research Group on Community Nutrition and Oxidative Stress; University of Balearic Islands, E-07122 Palma de Mallorca, Spain [4] Llussà, R; Research Group on Community Nutrition and Oxidative Stress; University of Balearic Islands, E-07122 Palma de Mallorca, Spain [5] Pons, A; Research Group on Community Nutrition and Oxidative Stress; University of Balearic Islands, E-07122 Palma de Mallorca, Spain [6] Tur, JA; Research Group on Community Nutrition and Oxidative Stress; University of Balearic Islands, E-07122 Palma de Mallorca, Spain.

Objective: To analyse trends in food consumption in the Balearic Islands adult population from 1999 to 2010. **Design:** Two consecutive cross-sectional nutrition surveys were carried out on random samples of the Balearic Islands adult population (ENIB Survey 1999-2000 and OBEX Survey 2009-2010). Analysis is based on a total of 2264 individuals: 1200 from ENIB 1999-00 (498 men and 702 women) and 1064 from OBEX 2009-10 (455 men and 609 women), aged 16-65 years. **Method:** A validated semi-quantitative food frequency questionnaire was used to ascertain tendencies in food consumption. Data were compared with the dietary guidelines for the Spanish population (Aranceta et al., Public Health Nutr 2001;4:1403-1408). **Results:** The trends from 1999 to 2010 showed an increase in consumers for meat, fish, eggs, milk and dairy products, fruit, sugar and cakes, unhealthy snacks, fast foods and soft drinks. Notable decreases in olive oil as well as in vegetables, potatoes, cereals, bread, nuts, and alcohol were observed. Little variation was observed for the rest of the food groups in the period studied. **Conclusion:** Based on the food consumption trends observed in the Balearic Islands, an increase in the consumption of fruits and vegetables, olive oil, pulses, as well as whole grain cereals and fish should be promoted, along with a reduction in the consumption of meat and derivatives, as well as in sugar and cakes, unhealthy snacks, fast food and soft drinks is recommended.

(Programme of Promotion of Biomedical Research and Health Sciences, Project 08/1259, and Predimed Network-RTIC RD06/0045/1004).

V. RECAPITULACIÓN



Hábitos alimentarios

La población adulta de las Islas Baleares está presentando modificaciones importantes en sus hábitos alimentarios y vale la pena considerarlos para así poder establecer políticas alimentarias que garanticen una vida más saludable, además de promover la conservación de la tradicional dieta mediterránea.

La población analizada en este estudio consistió en una muestra representativa de la población adulta de las Islas Baleares de 16 a 65 años de edad, donde sus hábitos alimentarios se caracterizan por un mayor consumo de leche y productos lácteos, vegetales, frutas, cereales y pan, carne, pescado y bebidas azucaradas; pero al comparar estos hábitos con la población española en general, se observan cambios importantes que, a su vez, difieren de la tradicional y saludable dieta mediterránea.

De acuerdo a las guías alimentarias para la población española, los adultos de las Islas Baleares sólo muestran un consumo apropiado de leche, productos lácteos, frutos secos, patatas, cereales, pan y agua. Mientras que el consumo de fruta, vegetales, aceite de oliva, huevos y leguminosas están por debajo de los niveles deseables. Al considerar la edad de los sujetos, se observa que el grupo de 16 a 25 años consume más carne, leche, productos lácteos, otros aceites y grasas distintos al aceite de oliva, patatas, cereales, azúcar y bollería, así como bebidas azucaradas; pero la ingesta de estos productos disminuye a medida que la edad aumenta. En cambio, el consumo de pescado, aceite de oliva, vegetales, fruta, frutos secos y pan aumenta con la edad.

En comparación con la pirámide de la alimentación saludable para la población española, se observa una ingesta inadecuada de frutas y vegetales, leguminosas y aceite de oliva, aunque el porcentaje de consumidores de aceite de oliva sea aún mayor que los consumidores de otras grasas y aceites. Estos cambios reflejan hábitos alimentarios inadecuados y, a su vez, una pérdida de adherencia a la dieta mediterránea. Los alimentos que representaron el mayor porcentaje de la ingesta en los adultos de las Islas Baleares fueron: pan, vegetales crudos, fruta entera, leche semidescremada, huevos, aceite de oliva,

aderezos, tartas, refrescos. La cerveza fue la bebida alcohólica más consumida.

También se procedió a evaluar la población mediante las recomendaciones de los factores dietéticos incluidos en las guías alimentarias de la OMS/FAO. Más de la mitad de los adultos de las Islas Baleares no cumplen con las recomendaciones, principalmente en grasa total, carbohidratos, ácidos grasos poliinsaturados, fibra dietética y sodio. El porcentaje de mujeres que cumplen la recomendación de acuerdo a estos nutrientes es mayor con respecto a los hombres, principalmente en grasas saturadas (31.5%), monoinsaturadas (38.6%), poli-insaturadas (13.5%), colesterol (54.4%), y fruta y vegetales (58.8%). Los valores promedio de consumo para las guías alimentarias de la OMS/FAO muestran una diferencia significativa entre el mayor y el menor cuartil de grasa total, grasa saturada, frutas y vegetales y fibra dietética de los objetivos comunes para la nutrición saludable. La baja ingesta de fibra dietética puede estar asociada a una baja ingesta de frutas y vegetales.

En los últimos diez años, los cambios observados en los hábitos alimentarios de los adultos de las Islas Baleares son similares a los ocurridos a nivel mundial; en muchos casos, estas variaciones parecen estar orientadas a patrones de alimentación más saludables, mientras que en otros casos se puede observar una clara preferencia por alimentos poco saludables (Fulgoni *et al.* 2007; Serra-Majem *et al.* 2007; Varela *et al.* 2010). La Sociedad Española de Nutrición comunitaria (SENC), en el 2010 ha publicado los objetivos finales de nutrición para la población española (Serra-Majem & Aranceta, 2009) y bajo estos criterios se han evaluado los hábitos alimentarios de la población adulta de las Islas Baleares.

La dieta en esta región del Mediterráneo se caracteriza por un alto consumo de alimentos que son la fuente principal de proteínas y grasas, entre los que destacan huevos, carne, productos lácteos, aderezos y otros, situación que se refleja en un incremento respecto a la recomendación de la ingesta de energía procedente de las proteínas, que se mantiene elevada con un 17% del total de

la energía, las grasas totales mostraron un aporte superior al 35% de la energía y las grasas saturadas con más del 10% de la energía de la dieta.

Contrario a ello, la ingesta de fruta es inferior a lo marcado por los objetivos nutricionales; el incremento registrado en los últimos diez años apenas alcanza una ingesta promedio de 276.8 g/día de fruta, cuando la recomendación debería ser mayor a los 400 g/día. Situación similar se observa para la ingesta de fibra dietética, con 17.2 g/día, una ingesta que no supera la recomendación, la cual debe ser mayor a 25 g/día.

La ingesta de vegetales también fue inferior a la recomendación, aunque sin mostrar diferencias significativas entre las encuestas realizadas en los últimos diez años; en este caso el objetivo es tener una ingesta superior a los 300 g/día, por lo que la ingesta de vegetales se mantiene muy por debajo a la recomendación al mostrar un consumo promedio de 168.2 g/día. Esta disminución en la ingesta de frutas y vegetales se reflejó en los valores de ingesta de folatos, los cuales fueron inferiores a la recomendación.

La ingesta de calcio y yodo también muestra una ligera disminución respecto a la recomendación; esto quizá sea debido a una baja ingesta de alimentos como vegetales de hoja verde, frutos secos, semillas y productos del mar; estos últimos, a pesar de que la población esté muy cercana al mar, ocupan la tercera posición según el porcentaje de contribución a la ingesta diaria de alimentos, situación que puede estar asociada al poder adquisitivo de la población.

Prevalencia de obesidad

La prevalencia de obesidad en España continua en incremento afectando a más del 13% de la población adulta, lo cual representa un evidente problema de salud pública (Serra-Majem & Aranceta, 2009). El promedio del índice de masa corporal para la población adulta española está estimado en un valor de 25.5 kg.m⁻², lo que se ha traducido en el objetivo intermedio de alcanzar un IMC promedio inferior a 25.5 kg.m⁻² (IMC de 21–23 kg.m⁻²) el cual se

corresponde con el percentil 40. En este sentido, la prevalencia de obesidad en las Islas Baleares mostró un incremento en los últimos diez años en hombres y mujeres con un promedio general de 25.16 kg.m^{-2} , el 40% de la población balear según su IMC mostró sobrepeso u obesidad. A pesar de ello, podemos hablar de una población que, en general, se muestra aún ligeramente activa, pues el nivel promedio de actividad física mostró un valor de $\text{PAL}=1.67$, ligeramente inferior al valor recomendado de $\text{PAL}>1.75$ (Ortega *et al.* 2004). El incremento en la actividad física es claro a partir de los 26 años, aunque cabe destacar que puede estar influido por el tipo de trabajo y horarios de jornada, entre otros factores.

Calidad de la dieta

La calidad de la dieta fue evaluada mediante dos métodos, el primero fue realizado de acuerdo a la versión adaptada a la dieta mediterránea del Índice Internacional de la Calidad de la Dieta (DQI-I) (Tur *et al.* 2005; Mariscal-Arcas *et al.* 2007) y el segundo mediante el Índice de Alimentación Saludable (HEI-2005) (Gunther *et al.* 2007).

La puntuación total para DQI-I fue de 47.39 sobre un total de 100 puntos, valor que clasifica la calidad de la dieta como deficiente, las mejores puntuaciones fueron obtenidas en las categorías de adecuación para el grupo de proteína, hierro y vitamina C, pero una puntuación pobre para vegetales, granos, frutas y fibra. En la categoría de moderación, la puntuación más baja fue para grasa total, grasa saturada y calorías vacías y una puntuación mayor para colesterol y sodio. En la categoría de variedad, la mayor puntuación fue para la variedad de grupos de alimentos y la puntuación más baja para variedad de fuentes de proteína. En el balance general la mayor puntuación fue para el balance de macronutrientes (carbohidratos – proteínas - grasas) con un promedio de 4.58 sobre un total de 6 puntos y la proporción de ácidos grasos obtuvo una puntuación de 3.61 sobre un total de 4 puntos.

De acuerdo al Índice de alimentación Saludable (HEI), la puntuación general para la calidad de la dieta fue de 50.42 sobre un total de 100 puntos; la

puntuación más alta fue para los componentes de carne y legumbres, leche, grasa saturada, aceites, SoFAAS (representa las calorías de grasa sólida, alcohol y azúcar añadida) y una puntuación más baja para el total de fruta, total de vegetales, vegetales verdes, vegetales de color naranja, legumbres y granos enteros, por lo tanto a través de este índice (HEI) podemos afirmar que la calidad de la dieta de las Islas Baleares es deficiente, ya que no alcanza el rango de puntuación considerado como bueno, el cual está definido entre 80 y 100 puntos.

Al evaluar la adecuación de la ingesta de nutrientes, se observó que más del 50% de la población tiene una ingesta menor que las IDR (Ingestas diarias recomendadas) de magnesio, calcio, yodo, zinc, retino, vitamina D, vitamina E, ácido pantoténico y ácido fólico; todos los grupos de edad mostraron un incremento en el porcentaje de individuos con ingesta superior o igual a las IDR de hierro, yodo, tiamina, vitamina B₆, niacina y ácido fólico.

En el grupo de edad de 16 a 25 años el incremento se observó en vitamina D y vitamina E y una disminución en fósforo. En el grupo de 26 a 45 años el incremento fue en fósforo, vitamina D, calcio, vitamina B₁₂, zinc y vitamina C y en el grupo de 46 a 65 años el incremento sólo se observó en zinc y vitamina C. En el caso de la ingesta de antioxidantes, se observó que más del 70% de la población tiene una ingesta superior o igual a las IDR de Selenio y vitamina C, mientras que en el caso del zinc menos del 30% muestra una ingesta superior o igual a las IDR y menos del 3.3% mostró tener una ingesta superior o igual a las IDR de retinol.

Frecuencia de alimentación

Por último, se observó que los patrones de alimentación de la población balear están asociados a una serie de factores; por ejemplo, se pudo observar que las personas con sobrepeso u obesidad reportaron una frecuencia de comidas inferior a tres tomas por día, mientras que las personas con normopeso reportaron tener 4 o 5 o más tomas de comida por día.

Más del 60% de la población realiza sus comidas en casa e incluso durante el fin de semana, lo que es satisfactorio para una mejor nutrición y conservación de hábitos alimentarios saludables; este hecho puede ser un aspecto positivo para promover el consumo de alimentos que en los últimos diez años han mostrado una disminución en la ingesta y que son característicos de la dieta mediterránea, tal es el caso del aceite de oliva que, a pesar de mostrar una disminución en su consumo, sigue siendo uno de los ingredientes principales de la dieta por ser mayormente utilizado para cocinar, freír y aliñar ensaladas; situación similar fue observada en otros grupos de alimentos como otras grasas y aceites, vegetales, fruta, frutos secos, leguminosas, patatas, cereales y pan, donde el 30% de la población no cumple con las raciones diarias recomendadas.

Por el contrario, podemos decir que casi en su totalidad, ya sea en menor o mayor cantidad, la población excede las recomendaciones en el grupo de carne, pescado y huevos, no siendo así para leche y productos lácteos ya que el 47.2% de la población cumple con las RDS. Por otro lado, el porcentaje de cumplidores de las RDS fue mayor para los grupos de alimentos de azúcares y bollería, bebidas dulces y alcohol.

Por lo tanto, se demuestra que los hábitos alimentarios, el patrón de consumo de alimentos y la calidad de la dieta de la población adulta de las Islas Baleares muestran características que la separan de la dieta mediterránea, sobre todo en la población más joven.

VI. CONCLUSIONES



1. La población adulta de las Islas Baleares debe disminuir el consumo de carne, azúcar, bollería y bebidas dulces e incrementar el consumo de aceite de oliva, frutas, vegetales, pescado y leguminosas, para cumplir con las directrices dietéticas saludables sugeridas por la Sociedad Española de Nutrición Comunitaria (SENC).
2. La adherencia a las guías alimentarias y objetivos comunes de nutrición en salud pública en los adultos de las Islas Baleares es baja, por lo que es necesario el análisis continuo y detallado de los patrones de consumo de alimentos y hábitos alimentarios, que permitan definir con claridad las diferencias entre hábitos alimentarios saludables y dieta ideal, lo que permitirá definir las mejores estrategias y políticas de intervención nutricional, necesarias para promover cambios positivos en los patrones de consumo, manteniendo las características de una dieta mediterránea saludable.
3. La dieta de los adultos de Baleares está caracterizada por un exceso en el aporte de energía procedente de las proteínas, grasas totales, grasa saturada y colesterol. Un bajo aporte de energía procedente de los carbohidratos, así como una baja ingesta (g/día) de fruta, vegetales y fibra. La alta ingesta de grasa es un aspecto importante a considerar debido a su asociación al riesgo de padecer enfermedades coronarias. Incrementar el consumo de pescado, frutos secos, leguminosas, aceite de oliva, fruta y vegetales favorecerá un mejor equilibrio en la ingesta de los ácidos grasos monoinsaturados y poliinsaturados, principalmente de las fuentes importantes de los n-3 y n-6, además de favorecer el incremento de las IDR de nutrientes relacionados con enfermedades carenciales (folatos, yodo y calcio) y los nutrientes con función antioxidante (selenio, zinc, retinol, vitamina C y carotenoides).
4. De acuerdo al Índice de Calidad de la Dieta (DQI-I), la dieta de los adultos de las Islas Baleares muestra una baja adherencia a la dieta Mediterránea, con una puntuación de 47.4%, ya que 53.7% de la población omite hasta tres grupos de alimentos por día en su dieta, un

84% integra menos de dos diferentes fuentes de proteína a la dieta, un 82% consume menos del 50% de la recomendación de vegetales y el 72% consume menos del 50% de la recomendación de granos enteros. La puntuación en el balance general de la dieta también fue bajo, con un promedio de 3.6% para el balance en la proporción de ácidos grasos (PUFA+MUFA)/SFA y el 4.6% para el balance de macronutrientes (carbohidratos-proteínas-grasas).

5. Según el Índice de Alimentación Saludable (HEI), la calidad de la dieta de Baleares es deficiente, pues la puntuación total obtenida fue de 50.4%. Las puntuaciones más bajas fueron obtenidas para los grupos de fruta, vegetales, leguminosas y granos enteros, mientras que el mayor puntaje fue para carnes, grasa saturada, aceites y SoFAAS (calorías de grasa sólida + alcohol + azúcar añadida).
6. Los hábitos alimentarios de la población balear han cambiado en los últimos años; cada vez son más las personas que realizan menos de tres tomas de comida al día (28.6%) y que por su condición ocupacional deciden comer fuera de casa, incluidos los fines de semana. El 66% de la población se percibe con sobrepeso u obesidad, pero sólo el 13.3% refirió estar bajo tratamiento dietético y el 71% refirió haberse sometido a tratamiento dietético en los últimos 12 meses. Un cambio positivo fue percibido en el hábito de consumo de tabaco y alcohol, pues son menos las personas que fuman con regularidad o que consumen menos de un cigarrillo por día; en el caso del alcohol son más las personas que se consideran abstemios, y menor quienes beben de manera esporádica, en fin de semana o diariamente.

Conclusión final.

Por último, podemos concluir que los hábitos alimentarios, el patrón de consumo de alimentos y la calidad de la dieta de la población adulta de las Islas Baleares muestran características que la separan de la dieta mediterránea, sobre todo en la población más joven. Resulta imprescindible continuar con el análisis exhaustivo de los datos obtenidos, que permitan la comprensión total de los factores determinantes al abandono de la dieta mediterránea, así como a las variaciones del estado nutricional y el desequilibrio de la ingesta de energía y nutrientes; además de favorecer la evaluación del impacto de las intervenciones y reorientar las políticas de nutrición, principalmente en los grupos identificados como de alto riesgo.

VII. BIBLIOGRAFÍA



Aranceta J. Nutrición Comunitaria. 2ª Edición. Masson S.A. 2001.

Aranceta J, Pérez Rodrigo C, Equileor I, Marzana I, González de Galdeano L, Saenz de Buruaga J. Food consumption patterns in the adult population of the Basque Country (EINUT-I). Public Health Nutr. 1988; 1(3):185-92.

Aranceta J, Pérez C, Gondra J, González de Galdeano L, Saenz de Buruaga J: Fat and alcohol intake in Basque Country. Eur J Clin Nutr. 1993; 47: Suppl 1:S66-S70.

Aranceta J, Spanish food patterns. Public Health Nutr. 2001;4:1399-402.

Aranceta J. Dietary guidelines for the Spanish population. Public Health Nutr. 2001; 4:1399-1402.

Bellido Guerrero D, Carreira Arias J, Soto González A, Martínez Olmos M. Análisis de la composición corporal. Tratado de nutrición: Nutrición humana en el estado de salud. 2ª Ed. 2010.

Berg A, Austin J. Nutrition and programes: a decade of direction. Food policy 1984; 9:304-12.

Bibiloni MM, Martínez E, Llull R, Pons A, Tur JA. Western and Mediterranean dietary patterns among Balearic Islands' adolescents: socio-economic and lifestyle determinants. Public Health Nutr. 2011; 8:1-10.

Bond Brill J. The Mediterranean diet and your health. Am J Lifestyle Medicine. 2009; 3:44-56.

Cade J, Thompson R, Burley V, Warm D. Development, validation and utilisation of food frequency questionnaires: a review. Public Health Nutr. 2001; 5: 567-587.

de Haen H, Thompson B. food security in a World without borders. *Forum Nutr.* 2003; 56: 375-9.

Feinberg M, Favier JC & Ireland-Ripert J (1995) *Répertoire général des aliments*. París: Tec & Doc Lavoisier.

Fitzgerald A, Dewar R & Veugelers P (2002) Diet quality and cancer incidence in Nova Scotia, Canada *Nutr Cancer.* 43, 127–132.

Fogelholm M, van Marken Lichtenbelt W. Comparison of body composition methods: a literature analysis. *Eur J Clin Nutr.* 1997; 51:495-503.

Freedman LS, Gunther PM, Krebs-Smith SM, Kott PS. A population's mean Healthy Eating Index-2005 score are best estimated by the score of the population ratio when one 24-hours recall is available. *J Nutr.* 2008; 138:1725-1729.

Fregapane G & Asencio-García C. Dietary assessment of an educated young Spanish population using a self administered meal based food frequency questionnaire. *Eur J Epidemiol.* 2000; 16:183-191.

García-Armesto S, Begoña abadía-Taira M, Durán A, Hernández-Quevedo C, Bernal-Delgado E. Spain: Health system Review. *Health System Transit.* 2010; 12:1-295.

Gómez C, Kohen VL, Nogueira TL: *Guía visual de alimentos y raciones*. Madrid: EDIMSA, 2007.

Goodpaster BH. Measuring body fat distribution and content in humans. *Curr Opin Nutr Metab Care.* 2002; 5:481-7.

Guenther PM, Reedy J, Krebs-Smith SM, Reeve BB, Basiotis PP. Development and evaluation of the Healthy Eating Index-2005. Technical Report.

- Center of Nutrition Policy and Promotion, U.S. Department of Agriculture 2007. Available at <http://www.cnpp.usda.gov/HealthyEatingIndex.htm>.
- Guo X, Warden BA, Paeratakul S, Bray GA. Healthy eating index and obesity. *Eur J Clin Nutr.* 2004; 58:1580-1586.
- Haines PS, Siega-Riz AM, Popkin BM. The diet Quality Index Revised: A Measurement Instrument for populations. *J Am Diet Assoc.* 1999; 99:697-704.
- Hann CS, Rock CL, King I, Drewnowski A. Validation of the healthy eating index with use of plasma biomarkers in clinical sample of women. *Am J Clin Nutr.* 2001; 74:479-86.
- Holmes B, Dickat K, Nelson M. A comparison of four dietary assessment methods in materially deprived households in England. *Public Health Nutr.* 2007; 11:444-456.
- HU FB. Dietary patterns analysis: a new direction in nutritional epidemiology. *Curr Opin Lipidol.* 2002; 13:3-9.
- Institut d'Estadística de les Illes Balears (IBESTAT). <http://www.ibestat.es/> (accessed April 2011).
- Jebb SA, Elia M. Techniques for the measurement of body composition: a practical guide. *Int J Obes Relat Metab Disord.* 1993; 17:611-21.
- Jen C, Brogan K, Washington OGM, Flack JM, Arinian NT. Poor nutrient intake and high obese rate in an urban African American population with hypertension. *J Am Coll Nutr.* 2007; 26:57-65.
- Jerome NW, Ricci JA. Food and nutrition surveillance: an international overview. *Am J Clin Nutr.* 1997; 65:1198S-1202S.

Jiménez S, Morón C. *Documento de base para la discusión de la conferencia electrónica de la red SISVAN, Red SISVAN y Oficina Principal de la FAO en Política Alimentaria y Nutrición.* <http://www.rlc.fao.org/foro/sisvan/sisvan.pdf>.

kant KA and Graubard BI. Secular trends in patterns of self reported food consumption of adult Americans: NHANES 1971-1975 to NHANES 1999-2002. *Am J Clin Nutr.* 2006; 84:1215-1223.

Kelemen LE. GI Epidemiology: nutritional epidemiology. *Aliment Pharmacol Ther.* 2007; 25:401-7.

Kushi LH. Gaps in epidemiology research methods: design considerations for studies that use food frequency questionnaires. *Am J Clin Nutr.* 1994; 59:180S-184S.

Kyle UG, Piccoli A, Pichard C. Body composition measurements: interpretation finally made easy for clinical use. *Curr Opin Nutr Metab Care.* 2003;6:387-93.

Lapunzina P, Aiello H. *Manual de antropometría normal y patológica.* MASSON, 2006.

Lee SY, Gallagher D. Assessment methods in human body composition. *Curr Opin Nutr Metab Care.* 2008; 11:566-72.

Lock K, Smith RD, Dangour AD, Keogh-Brown M, Hawkes C, Fisberg RM, Chalabi Z. Health agricultural, and economic effects of adoption of healthy diet recommendations. *Lancet.* 2010; 13:1699-709.

Macdonald AJ, Greig CA, Baracos V. The advantages and limitations of cross-sectional body composition analysis. *Curr Opin Nutr Metab Care.* 2011, oct. 7.

- Mariscal-Arcas M, Romaguera D, Rivas A, Feriche B, Pons A, Tur JA, Olea-Serrano F. Diet quality of young people in southern Spain evaluated by a Mediterranean adaptation of the diet Quality Index-International (DQI-I). *Br J Nutr.* 2007; 98:1267-1273.
- Martín-Moreno JM, Boyle P, Gorgojo L, Maisonneuve P, Fernández-Rodríguez JC, Salvini S, Willet WC: Development and validation of a food frequency questionnaire in Spain. *Int J Epidemiol.* 1993;22:512-519.
- Mataix J, Mañas M, Llopis J, Martínez de Victoria E, Juan J & Borregón A (2004) *Tablas de composición de alimentos españoles (Spanish food composition tables)*, 4th ed. Granada: INTA-Universidad de Granada.
- McCullough M, Feskanich D, Stampfer M, Rosner B, Hu F, Hunter D, Variyan J, Colditz G & Willett W (2000) Adherence to the Dietary Guidelines for Americans and risk of major chronic disease in women. *Am J Clin Nutr.* 72:1214–1222.
- Michels KB. Nutritional epidemiology, past, present, future. *Int J Epidemiol.* 2003; 32:486-488.
- Moreiras O, Carvajal A, Cabrera L, Cuadrado C: *Tablas de composición de alimentos (Food composition tables)*, ed 7th Madrid: Pirámide 2003.
- National Research Council: Committee on Diet and Health. Food and Nutrition Board, Commission on Life Sciences. *Diet and Health: Implications for reducing chronic disease risk.* Washington DC: National Academy of Sciences, 1989.
- Neira M & de Onis M. The Spanish strategy for nutrition, physical activity and the prevention of obesity. *Br J Nutr.* 2006; 96:S8-S11.

- Newby PK, B Hu F, B Rimm E, Smith-Warner SA, Feskanich D, Sampson L, C Willett W. Reproducibility and validity of the Diet Quality Index revised as assessed by use a food frequency questionnaire. *Am J Clin Nutr.* 2003; 78:941-9.
- Ortega Anta RM, López Sobaler AM, Requejo Marcos AM, Carvajales PA: La composición de los alimentos. Herramientas básicas para la valoración nutricional. Departamento de Nutrición. Facultad de Farmacia, Universidad Complutense de Madrid, 2004.
- Ortega RM. Food pregnancy and lactation. Dietary guidelines for pregnant women. *Public Health Nutr.* 2001; 4:1343-1346.
- Pierre Cotier & Morón C. Producción y manejo de datos de composición química de alimentos en nutrición. Departamento de Agricultura FAO <http://www.fao.org/docrep/010/ah833s/AH833S07.htm>.
- Ribas Barba L, Serra Majem L, Salvador G, Castell C, Cabezas C, Salleras L, Plasencia A. Trends in dietary habits and food consumption in Catalonia Spain (1992-2003). *Public Health Nutr.* 2007; 10:1340-53.
- Ripoll L (1992) *Cocina de las Islas Baleares (The Balearic Islands Cokery)*, 5 th ed. Palma de Mallorca: L. Ripoll.
- Romaguera Bosch D. Evaluación del estado nutricional y la calidad de la dieta en poblaciones en proceso de transición nutricional. Tesis Doctoral, Universitat de les Illes Balears, Palma de Mallorca, 2007.
- Román-Viñas B, Ribas Barba L, Ngo J, Martínez-González MA, Wijnhoven TM, Serra-Majem L. Validity of dietary patterns to assess nutrient intake adequacy. *Br J Nutr.* 2009; 2:12-20.
- Savoca MR, Arcury TA, Leng X, Bell RA, Chen H, Anderson A, Kohrman T, Quandt SA. The diet quality of rural older adults in the south as measured

- by Healthy Eating Index-2005 varies by ethnicity. *J Am Diet Assoc.* 2009; 109:2063-2067.
- Schäfer W, Kroneman M, Boerma W, van den Berg M, Westert G, Devillé W, van Ginneken E. The Netherlands: health system review. *Healthy Syst Transition* 2010;12:1-228.
- Serra Majem L, Ribas Barba L, Salvador G, Jover L, Raidó B, Ngo J, Plasencia A. Trends in energy and nutrient intake of inadequate intakes in Catalonia, Spain (1992-2003). *Public Health Nutr.* 2007; 10:1354-67.
- Serra Majem L, Ribas Barba L, Salvador G, Serra J, Castell C, Cabezas C, Plasencia A. Compliance with dietary guidelines in the Catalan population: basis for a nutrition policy at the regional level (the PAAS strategy). *Public Health Nutr.* 2007;10:1406-1414.
- Serra-Majem L, Aranceta Bartrina J. *Nutrición y Salud Pública: Métodos, bases científicas y aplicaciones.* 2ª Edición, Elsevier 2006.
- Serra-Majem L, Ribas Barba L, Aranceta Bartrina J. *Evaluación del consumo de alimentos en poblaciones: Encuestas alimentarias. Nutrición y Salud Pública: Métodos, bases científicas y aplicaciones.* 2ª Edición, Elsevier 2006.
- Serra-Majem L, Ribas L, Ramon JM. Compliance with dietary guidelines in the Spanish population. Results from the catalan nutrition survey. *Br J Nutr.* 1999; 81:105-112.
- Serra-Majem L, Roman B, Ribas Barba L. *Metodología de los estudios nutricionales.* Departamento de ciencias, Facultad de Medicina, Centro de Ciencias de la Salud, Universidad de Las Palmas de Gran Canaria, España. Centro de Investigación en Nutrición Comunitaria, Parc Científic de la Universitat de Barcelona. 2001.

- Seymour J, Calle E, Flagg E, Coates R, Ford E & Thun M (2003) Diet quality index as a predictor of short term mortality in the American Cancer Society cancer prevention study II nutrition cohort. *Am J Epidemiol.* 157:980–988.
- Soriano JM, Moltó JC, Mañes J. Dietary Intake and food patterns among university students. *Nutr Res.* 2000;20:1258-2000.
- Trichopoulou A, Kouris-Blazos A, Wahlqvist M, Gnardellis C, Lagiou P, Polychronopoulos E, Vassilakou T, Lipworth L & Trichopoulos D (1995) Diet and survival in elderly people. *BMJ* 311; 1457–1460.
- Tur JA, Romaguera D, Pons A. Food consumption patterns in a Mediterranean Region: Does the Mediterranean Diet Still Exist? *Ann Nutr Metab.* 2004; 48:193-201.
- Tur JA, Romaguera D, Pons A. The Diet Quality Index-International (DQI-I): is it a useful tool to evaluate the quality of the Mediterranean diet? *Br J Nut.* 2005; 93:369-376.
- Turrini A, Leclercq C, D'Amicis A. Patterns of food and nutrient intake in Italy and their application to the development of food-based dietary guidelines. *Br J Nut.* 1999; 81:S83--S89.
- US Department of Agriculture and US Department of Health and Human Services. Nutrition and your health: dietary guidelines for Americans. 5th ed. Washington, DC: US Departments of Agriculture and Health and Human Services, 1995.
- Wagner DR, Heyward VH. Techniques of body composition assessment: a review of laboratory and field methods. *Res. Q Exerc. Sport.* 1999; 70:135-49.

- Wakimoto P, Block G. Dietary intake, dietary patterns, and changes with age: an epidemiological perspective. *J Gerontol A Biol Sci Med Sci.* 2001; 2: 65-80.
- Willett W. Nutritional epidemiology: issues and challenges. *Int J Epidemiol.* 1987; 16:312-7.
- Wirt A, Collins CE. Diet quality – What is it and does it matter?. *Public Health Nutr.* 2009; 12:2473-2492.
- Wright CM, Sherriff A, Ward SC, McColl JH, Reilly JJ, Ness AR. Development of bioelectrical impedance derived indices of fat and fat free mass for assessment of nutritional status in childhood. *Eur J Clin Nutr.* 2008; 62:210-7.