UNIVERSITAT DE LES ILLES BALEARS

Grup de Recerca en Nutrició Comunitària i Estrès Oxidatiu

Departament de Biologia Fonamental i Ciències de la Salut

Laboratori de Ciències de l'Activitat Física

ESTUDI DE LA PREVALENÇA DE L'OBESITAT JUVENIL A LES ILLES BALEARS

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Presentada per

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La interessada

Amb el beneplàcit del Director

Maria del Mar Bibiloni Esteva

Dr. Josep Antoni Tur Marí

Catedràtic d'Universitat,

Àrea de Fisiologia

«Mentre els somnis no se'm facin petits,
els continuaré pintant de colors,
lluitant perquè la fosca,
no se'm porti l'arc de Sant Martí»

Agraïments

El desenvolupament d'una Tesi doctoral és un treball atraient, interessant, satisfactori, autorealitzador i creatiu. Però a la vegada és un treball absorbent, llarg i on malauradament les dificultats també hi són presents. I en finalitzar, és inevitable concentrar la major part del mèrit al propi esforç. No obstant això, una Tesi és el resultat d'anys de feina en el que, directa o indirectament, han participat vàries persones, ja sigui en l'aportació, recol·lecta i informatització de dades; llegint, opinant i corregint els manuscrits i la Tesi en si; com tenint paciència i acompanyant en els moments de crisi i en els moments de felicitat. Per aquest motiu, és un plaer emprar aquest espai per a expressar els agraïments:

Al meu director de Tesi, el **Dr. Josep A. Tur,** *per acceptar-me per a realitzar aquesta Tesi doctoral sota la seva direcció. Però especialment, per haver confiat amb mi i haver fet possible amb el seu interès, dedicació, comentaris, correccions i paciència que aquesta Tesi sortís endavant. Les idees pròpies amb la seva orientació i rigurositat han estat clau del bon treball realitzat junts. Li agraeixo també haver-me permès participar en molts altres projectes i treballs, i el fet d'haver-me facilitat sempre els mitjans suficients per a realitzar totes les activitats proposades durant el desenvolupament de la Tesi i que han enriquit la meva formació. Moltes gràcies Pep.*

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Durant segles, en algunes cultures i filosofies l'obesitat ha estat considerada indicativa de salut, bellesa, fertilitat i poder. I de fet, si s'analitza la figura humana en el temps a través de la imatge plàstica, probablement l'obra més antiga coneguda sigui precisament la figura de la Venus de Willendorf (Paleolític Superior, 20.000-30.000 anys aC), una dona petita i grassa, sense rostre, i amb natges i pits voluminosos[1]. I és que la percepció de la figura humana en la societat ha quedat reflectida en les obres dels artistes des de la prehistòria.

La Verge amb el fill de Crist i Sant Joan Baptista atribuït a Lorenzo di Credi (1459-1537), la Venus del mirall (1615) i Les tres gràcies de Peter Paul Rubens (1636-1639), el retrat del Toscà General Alessandro del Borro atribuït a Charles Mellin (1645), i La dona al pou de Pierre Auguste Renoir (1910) són algunes de les obres pictòriques en les que l'obesitat és representada com a model de bellesa[1,2].

I és que no fou fins la segona meitat del segle XX que l'obesitat es va relacionar amb el risc cardiovascular i altres malalties, donant lloc a un canvi important en la percepció de l'obesitat: el cos voluminós deixa d'ésser símbol d'una bona salut i bellesa, convertint-se l'obesitat en sinònim de frustració, pobresa, estrès i infelicitat. I així ho han reflectit els artistes en les seves obres, emprant la imatge voluminosa com a símbol de conflicte entre l'individu i la societat[1].

Paral·lelament i fins avui dia, imatges de dones primes, a vegades quasi desnodrides, i homes amb un físic esculpit es difonen com a símbol de bellesa en els mitjans de comunicació[1].

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[1] Ferrucci L, Studenski SA, Alley DE, Barbagallo M, Harris TB. Obesity in aging and art. J Gerontol A Biol Sci Med Sci 2010;65A(1):53-56.

[2] Álvarez R. Estética de la obesidad en el arte. Arte y Medicina 2010(53);4:49

Índex / *Index*

Abreviatures / *Abbreviations*

Organitzacions, altres entitats i activitats / *Organizations, other entities and activities*

Català / *Catalan*

AEP	Associació Espanyola de Pediatria
AVENA	Alimentació i Valoració de l'Estat Nutricional en els Adolescents
ENIB	Estudi de Nutrició de les Illes Balears
ENS	Enquesta Nacional de Salut
OBIB	Obesitat Infantil i Juvenil a les Illes Balears
OMS	Organització Mundial de la Salut
SEEDO	Societat Espanyola per a l'Estudi de l'Obesitat

Anglès / *English*

CASPIAN	*Childhood and Adolescence Surveillance and Prevention of Adult Non-communicable disease (study)*
CCHS	*Canadian Community Health Survey*
CDC	*Centers for Disease Control and Prevention*
CNNHS	*China National Nutrition and Health Survey*
HBSC	*Health Behaviour in School-aged Children (study)*
IOTF	*International Obesity Task Force*
NCEP-ATPIII	*III National Cholesterol Education Program Adult Treatment Panel*
NCHS	*National Center for Health Statistics*
NHANES	*National Health and Nutrition Survey*
NSCH	*National Survey of Children's Health*
SA YRBS	*South African National Youth Risk Behaviour*
SPANS	*Schools Physical Activity and Nutrition Survey*
UK	*United Kingdom*
WHO	*World Health Organization*

Termes tècnics / *Technical terms*

Català / *Catalan*

AF	Activitat física
DE	Desviació estàndard
DM	Dieta Mediterrània
GC	Greix corporal
IC	Imatge corporal
ICM	Índex cintura:maluc
ICT	Índex cintura:talla
IE	Ingesta energètica
IMC	Índex de massa corporal
IMG	Índex de massa grassa
IMT	Íntima-mitja carotídia arterial
KIDMED	Índex de Qualitat de la Dieta Mediterrània
MG	Massa grassa
MLG	Massa lliure de grassa
P	Percentil
PCR	Proteïna C reactiva
QFC	Qüestionari de freqüència de consum d'aliments
SMet	Síndrome metabòlic
TG	Triglicèrids
TMB	Taxa metabòlica bassal
TV	Televisió

Anglès / *English*

AFAD-A	*Adiposity & Fat Distribution classification for adolescents*
BF	*Body fat*
BIA	*Bioelectrical Impedance Analysis*
BMI	*Body mass index*

BMR	*Basal metabolic rate*
BP	*Blood pressure*
CHO	*Carbohydrates*
CI	*Confidence interval*
DBP	*Diastolic blood pressure*
DEXA	*Dual-Energy X-ray Absorciometry*
DQI-I	*Diet Quality Index-International*
EI	*Energy intake*
FFM	*Fat-free mass*
FFQ	*Food frequency questionnaire*
FMI	*Fat mass index*
HC	*Hip circumference*
HDL	*High-density lipoprotein (cholesterol)*
IPAQ	*International Physical Activity Questionnaire*
LDL	*Low-density lipoprotein (cholesterol)*
MD	*Mediterranean diet*
MDP	*Mediterranean dietary pattern*
MDS	*Mediterranean Diet Score*
MetS	*Metabolic syndrome*
MUFA	*Monounsaturated fatty acids*
NS	*Not significant*
OR	*Odds ratio*
PA	*Physical activity*
PAI-1	*Plasminogen activator inhibitor-1*
PAL	*Physical Activity Level*
PUFA	*Polyunsaturated fatty acids*
Ref.	*Reference*
SBP	*Systolic blood pressure*
SCSF	*Subscapular skinfold*
SD	*Standard deviation*

SFA	*Saturated fatty acids*
ST	*Skinfold thickness*
TSF	*Triceps skinfold*
TV	*Television*
VLDL	*Very-low-density lipoprotein (cholesterol)*
WC	*Waist circumference*
WHR	*Waist-to-hip ratio*
WHtR	*Waist-to-height ratio*

ESTUDI DE LA PREVALENÇA DE L'OBESITAT JUVENIL A LES ILLES BALEARS

Tesi doctoral, Maria del Mar Bibiloni Esteva, Departament de Biologia Fonamental i Ciències de la Salut, Laboratori de Ciències de l'Activitat Física, Grup de Recerca en Nutrició Comunitària i Estrès Oxidatiu, Universitat de les Illes Balears, Palma de Mallorca, Espanya.

Resum

L'obesitat infanto-juvenil és un dels problemes de salut pública més greus del segle XXI. A Espanya, la prevalença d'obesitat en nins i adolescents ha augmentat considerablement els darrers anys, arribant a una de les taxes més altes d'obesitat infantil d'Europa. L'única referència disponible sobre la prevalença de sobrepès i obesitat juvenil a les Illes Balears procedeix d'un estudi realitzat l'any 1998 per l'equip de Nutrició Comunitària i Estrès Oxidatiu de la Universitat de les Illes Balears en els adolescents de la ciutat de Palma, en el qual la prevalença d'obesitat i sobrepès va ésser, respectivament, del 6.5% i 9.7% en al·lots i 3.5% i 12.3% en al·lotes de 17 anys. Aquests resultats, la tendència a un increment de la prevalença de l'obesitat infantil al nostre país en els darrers anys, l'occidentalització progressiva dels hàbits nutricionals entre la població jove i l'augment de la població immigrant a la nostra societat, ens indueix a suposar que avui en dia existeixen taxes elevades d'obesitat entre la població juvenil balear. Per tant, l'objectiu general d'aquesta Tesi fou conèixer la prevalença actual de sobrepès i obesitat en la població juvenil (12-17 anys) de les Illes Balears (2007-2008), els seus factors predictors (sociodemogràfics, estils de vida, qualitat de la dieta, activitat física, autopercepció de la imatge corporal) i comorbiditat i la seva evolució i tendència en els propers anys.

La prevalença de sobrepès (IMC≥P85-<P97) i obesitat (IMC≥P97) en els adolescents de les Illes Balears és de 17.5% i 10.4%, respectivament, similar a la d'altres països d'Europa. La prevalença d'obesitat és similar entre els al·lots i les al·lotes, però la prevalença de sobrepès i d'excés de greix corporal és major en els al·lots i disminueix amb l'edat. Un baix nivell educatiu i socioeconòmic dels pares, ometre menjades, la pràctica insuficient d'activitat física, dormir 7 o menys hores diàries als al·lots i el

consum ocasional de tabac a les al·lotes són factors associats a una major prevalença d'obesitat. Paradoxalment, la ingesta energètica és menor en els adolescents obesos, però cal indicar que als al·lots el desig d'aprimar-se està inversament associat amb la ingesta energètica.

La prevalença de la Síndrome Metabòlica en els adolescents de les Illes Balears és del 5.8%. Aquesta prevalença és major als al·lots (10.5%) que a les al·lotes (2.7%). Una alta adherència a la Dieta Mediterrània dificulta la gènesi d'aquesta patologia. Però, tot i que un sector dels adolescents exhibeix un patró d'alimentació Mediterrani, s'observa que, en general, la població juvenil de les Illes Balears es troba en una situació de transició nutricional. L'adherència a la Dieta Mediterrània és del 57.9%, només el 28.9% dels adolescents tenen una bona adherència a la Dieta Mediterrània i la qualitat global de la dieta és deficient. A més, s'identifiquen dos patrons dietètics principals: el patró dietètic "Occidental" i el patró dietètic "Mediterrani".

Per altra banda, la prevalença de sedentarisme en els adolescents de les Illes Balears és de 37.1% (22.0% dels al·lots i 50.8% de les al·lotes). Als al·lots els nivells d'activitat física i el comportament sedentari són independents un de l'altre; a les al·lotes, la disminució de la pràctica d'activitat física s'associa a un increment del temps dedicat a veure la TV i/o emprar l'ordinador (principalment als 14-15 anys) i a estudiar (principalment als 16-17 anys).

Per tant, els adolescents i les famílies han de tenir un millor coneixement de la relació entre la nutrició, l'activitat física, el pes corporal (o greix corporal) i la salut, principalment les classes socials de baixos nivells d'estudis i socioeconòmics, per tal de poder prendre millors decisions sobre la seva dieta i nivells d'activitat física i contribuir d'aquesta manera a la reversió responsable de l'estat de sobrepès i obesitat.

STUDY ON THE PREVALENCE OF OBESITY AMONG BALEARIC ISLANDS' ADOLESCENTS

PhD Thesis, Maria del Mar Bibiloni Esteva, Departament de Biologia Fonamental i Ciències de la Salut, Laboratori de Ciències de l'Activitat Física, Grup de Recerca en Nutrició Comunitària i Estrès Oxidatiu, Universitat de les Illes Balears, Palma de Mallorca, Espanya.

Summary

Obesity in childhood and adolescence is one of the most serious public health problems of the XXIth century. In Spain, the prevalence of obesity in children and adolescents has increased during the last years, reaching one of the highest rates of childhood obesity in Europe. The only reference on overweight and obesity prevalence available among Balearic Islands' youth was a study conducted in 1998 by the Research Group on Community Nutrition and Oxidative Stress, University of the Balearic Islands, among adolescents aged 17 years living in the city of Palma, where the estimated prevalence of obesity and overweight were 6.5% and 9.7% in boys, and 3.5% and 12.3% in girls, respectively. These results, trends toward an increased prevalence of childhood obesity lately in our country, the progressive Westernization of food habits among young people and an increase of immigrant population in our society induce us to assume that nowadays there are high rates of obesity among Balearic Islands' adolescents. Therefore, the aim of this PhD Thesis was to assess the current prevalence of overweight and obesity in the adolescent population (12-17 years old) of the Balearic Islands (2007-2008), its predictive factors (sociodemographic, lifestyle, diet quality, physical activity, and body image) and comorbidity and future trends and evolution.

The prevalence of overweight (BMI≥P85-<p97) and obesity (BMI≥p97) in the adolescent population of the Balearic Islands is 17.5% and 10.4% respectively, similar to other European countries. The prevalence of obesity is similar among boys and girls, but the prevalence of overweight and excess body fat is greater in boys and decreases with age in them. A low parental socioeconomic and educational level, to skip meals, to practice insufficient physical activity, to sleep 7 or fewer hours per day in boys and an

occasional tobacco consumption in girls are the main factors associated with a higher prevalence of obesity. Paradoxically, the energy intake is lower in obese adolescents, but it should be noted that in boys a desire to lose weight is inversely associated with energy intake.

The prevalence of Metabolic Syndrome among adolescents in the Balearic Islands is 5.8%. This prevalence is higher in boys (10.5%) than girls (2.7%). A high adherence to the Mediterranean diet hinders the genesis of this pathology. Although a young sector exhibits a Mediterranean diet pattern, it is observed that in general young population of the Balearic Islands is in a state of nutrition transition. Adherence to the Mediterranean diet is 57.9%, only 28.9% of adolescents have good adherence to the Mediterranean diet and overall quality of the diet is deficient. We have also identified two main dietary patterns: the "Western" dietary pattern and the "Mediterranean" dietary pattern.

Moreover, the prevalence of physical inactivity among adolescents in the Balearic Islands is 37.1% (22.0% of boys and 50.8% of girls). A displacement of physical activity to sedentary pursuits in girls with age is observed increasing time spent watching TV and/or use the computer (mainly in girls aged 14-15 years) and homework time (mainly in girls aged 16-17 years); whereas in boys the use of media-screen or homework time would not necessarily affect the physical activity practice.

Therefore, adolescents and families should have a better understanding of the relationship between nutrition, physical activity, body weight (or body fat) and health, particularly in low educational and socioeconomic classes, in order to make better decisions about own diet and physical activity practice and thereby contribute to the reversion of the overweight and obesity prevalence.

Llistat d'articles originals / *List of original papers*

I. Bibiloni MM, Martínez E, Llull R, Juárez MD, Pons A, Tur JA (2010) *Prevalence and risk factors for obesity in Balearic Islands adolescents.* British Journal of Nutrition 103:99–106.

II. Bibiloni MM, Martínez E, Llull R, Maffiotte E, Riesco M, Llompart I, Pons A, Tur JA (2011) *Metabolic syndrome in adolescents in the Balearic Islands, a Mediterranean region.* Nutrition Metabolism Cardiovascular Diseases 21:446–454.

III. Bibiloni MM, Martínez E, Llull R, Pons A, Tur JA (2011) *Western and Mediterranean dietary patterns among Balearic Islands' adolescents: socio-economic and lifestyle determinants.* Public Health Nutrition 15:683–692.

IV. Bibiloni MM, Pich J, Pons A, Tur JA. *Meal frequency, adiposity and food quality among the Balearic Islands' adolescents*(submitted).

V. Bibiloni MM, Pons A, Tur JA. *Defining body fatness in adolescents: IOTF reference, WHO standard or using different anthropometric indicators? A proposal of the AFAD-A classification*(submitted).

VI. Bibiloni MM, Pich J, Córdova A, Pons A, Tur JA. *Sedentary behaviour among the Balearic Islands' adolescents: socioeconomic and lifestyle determinants*(submitted).

VII. Bibiloni MM, Pich J, Pons A, Tur JA. *Body image and food consumption differences according to body composition among adolescents*(submitted).

VIII. Bibiloni MM, Pons A, Tur JA. *Meal patterns, dietary habits and compliance with Mediterranean Diet Quality Index (KIDMED) among Balearic Islands' adolescents*(submitted).

IX. Bibiloni MM, Pons A, Tur JA. *Diet quality (DQI-I) of Balearic Islands' adolescents: socioeconomic, lifestyle and body image determinants*(submitted).

X. Bibiloni MM, Pich J, Pons A, Tur JA. *Body dissatisfaction among Balearic Islands' adolescents: increasing or decreasing?*(submitted).

XI. Bibiloni MM, Pons A, Tur JA. *Prevalence of overweight and obesity in adolescents: a systematic review*(submitted).

INTRODUCCIÓ

1. SOBREPÈS I OBESITAT INFANTO-JUVENIL

1.1. Què és el sobrepès i l'obesitat?

El sobrepès i l'obesitat són definits per l'Organització Mundial de la Salut (OMS) com una «acumulació anormal o excessiva de greix que pot ésser perjudicial per a la salut» [1]. Mentre que en els nins, els depòsits de greix tenen lloc principalment a nivell subcutani, en els adolescents i els adults també es formen depòsits intraabdominals –patró que s'associa amb un major risc de trastorns metabòlics- [2]. Aleshores, la definició de sobrepès i obesitat hauria de complir dos criteris: (i) hauria de diagnosticar l'excés de greix corporal (GC), i (ii) hauria d'indicar un risc augmentat de problemes de salut [3].

1.2. Com es defineix i diagnostica el sobrepès i l'obesitat?

La definició (en epidemiologia) i el diagnòstic (en la pràctica clínica) [4] del sobrepès i l'obesitat es basen en una anàlisi de la composició corporal per a la detecció d'un excés de GC i de les complicacions metabòliques relacionades.

Per a estudiar la composició corporal, la massa corporal s'ha dividit clàssicament en dos components: la massa grassa (MG) i la massa lliure de grassa (MLG) [5,6]. La MG consta de tots els lípids del teixit adipós i d'altres teixits; mentre que la MLG inclou aigua, proteïnes i components minerals [6].

Però a l'actualitat, es considera que la millor aproximació és l'ús d'un model de components múltiples [5]. El model de quatre components es considera la mesura de la composició corporal més precisa [6] i es basa en la mesura del pes corporal, el volum corporal, l'aigua corporal total i el contingut mineral ossi, per a després determinar la massa corresponent a grassa, proteïna, aigua i minerals [5]. La diferència entre el model de tres components respecte al de quatre components és que omet la mesura del contingut mineral ossi [5]. Tot i així, molts dels mètodes de determinació de la composició corporal d'ús freqüent es basen en el model de dos components.

1.2.1. Mètodes de determinació de la composició corporal

Pel fet que la quantificació directa de la MG corporal consistiria en pesar directament el greix d'un cadàver [5,7], òbviament la quantificació es realitza per mètodes indirectes. És a dir, s'apliquen mètodes que estimen la quantitat de MG.

Existeixen diversos mètodes per a estimar el contingut de MG corporal (Taules 1 i 2). La hidrodensitometria, el desplaçament de l'aire per pletismografia, les tècniques de dilució i l'absorciometria de raigs X duals (DEXA) són els mètodes més fiables per obtenir mesures de la MG total. Per altra banda, la tomografia computaritzada i la imatge per ressonància magnètica són mètodes que a més, permeten quantificar la distribució del teixit adipós en visceral, subcutani i intermuscular [6]. De fet, aquests dos darrers mètodes són considerats els més precisos per a la quantificació de la composició corporal 'in vivo', en permetre no només la quantificació del teixit adipós, sinó també del múscul esquelètic i altres òrgans i teixits interns [6]. Tots aquests mètodes es coneixen com a «mètodes de referència» [8] i presenten el gran inconvenient de no ésser suficientment aplicables a la pràctica clínica i estudis epidemiològics. Per això, els mètodes antropomètrics –juntament amb la bioimpedància elèctrica- són els mètodes més emprats en estudis de gran escala, quan els recursos econòmics disponibles són baixos i es requereix d'una mesura de baix cost [6]. Els mètodes antropomètrics habituals són: diferents índex derivats de la combinació entre pes i talla, com l'índex de massa corporal (IMC), l'índex ponderal o l'índex de massa corporal percentual o relatiu; la circumferència de la cintura, del maluc o la seva combinació; la combinació entre la cintura i la talla; i l'estudi de plecs cutanis.

1.2.2. Quin és el millor mètode per a estimar el greix corporal?

La mesura ideal del GC ha de ser «precisa en l'estimació del GC, amb un error de mesura petit; accessible en termes de simplicitat i cost; fàcil d'emprar; acceptada pel subjecte; ben documentada i amb valors de referència que permeti la comparació entre poblacions» [9]. Però no hi ha cap mesura que satisfaci tots aquests criteris [9].

Per la seva facilitat d'aplicació i baix cost, els mètodes antropomètrics han estat els mètodes més emprats d'aproximació a l'excés de GC, tot i que la seva precisió és menor que la dels mètodes de referència [9-11]. Entre els mètodes antropomètrics, l'IMC és el paràmetre internacionalment més emprat per a la definició i el diagnòstic del sobrepès i l'obesitat, tant en la pràctica clínica com a l'epidemiologia [4,8,9,12-14]. I és que la comunitat científica ha recomanat l'ús de l'IMC per a classificar a la població en sobrepès i obesitat a partir dels 2 anys de vida [15].

1.2.2.1. L'índex de massa corporal (IMC)

En els adults, està àmpliament acceptat que una persona amb sobrepès és aquella que té un IMC entre 25 i 29.9 kg/m^2, i amb obesitat aquella que té un IMC igual o superior a 30 kg/m^2 [16], ja que existeixen evidències de l'increment de risc de mortalitat i morbiditat quan se sobrepassen aquests punts [16,17].

En els nins i els adolescents, la definició de sobrepès i obesitat és més complicada [18], ja que es troben en una situació de canvi permanent en quant a distribució i composició corporal a mesura que van creixent [16]. L'adolescència, en concret, és una etapa caracteritzada per a una acceleració del creixement i de maduració amb canvis diferencials entre ambdós sexes [16]. Així, per exemple, mentre que a les nines el desenvolupament puberal està associat amb un increment de la MG; als nins té lloc una disminució de la MG i un augment de la MLG, així com també pics de creixement majors [16]. Per aquest motiu, hi ha un consens en què per a definir el sobrepès i l'obesitat en nins i adolescents és més apropiat considerar l'IMC per edat i sexe, i emprar gràfiques de creixement percentilars que descriuen dades de referència poblacional, o calcular desviacions estàndards (*Z* score o *DE* score) relatius a les dades de referència poblacionals [4,19].

Cal assenyalar que tot i que hi ha una gran varietat de criteris per a definir el sobrepès i l'obesitat infanto-juvenil [20], igual que en els adults, està ben establert que en els nins i adolescents un alt IMC per edat està associat amb un risc incrementat d'una varietat de malalties [19,21,22]. Ara bé, tot i que l'IMC és considerat el millor mètode antropomètric d'estimació de la MG corporal disponible per a fins públics [23], la comparació de l'IMC amb els mètodes de referència indiquen que l'IMC té una sèrie de limitacions per a estimar la MG corporal de l'individu:

(i) La composició corporal pot canviar mentre que el pes, i per tant, l'IMC no canvia. Per exemple, la dieta i l'exercici pot reduir la MG i augmentar la massa muscular [23]. La relativa insensibilitat a canvis de composició corporal, i més concretament, la falta d'un canvi favorable en l'IMC pot desanimar un pacient que està treballant durament en el seu tractament de pèrdua de pes quan aparentment no s'està mostrant l'efecte desitjat [24]. I de fet, aquesta és una de les raons que pot fer que un pacient estigui menys adherit al seu pla de tractament [24].

Taula 1. Mètodes específics de determinació de la composició corporal.

Mètode	Descripció	Comentaris
Hidrodensitometria (*Hydrodensitometry, underwater weighting, UWW*) [6,54,70]	Es pesa el subjecte submergit en un tanc d'aigua (havent exhalat al màxim l'aire) i fora del tanc. Es basa en el principi d'Arquímedes: si la densitat d'un objecte és major que la de l'aigua, s'enfonsarà. Així, dues persones amb un mateix pes fora del tanc, el que tingui més MG pesarà menys en l'aigua que el que tingui més MLG. El volum també pot ser determinat a través de la quantitat d'aigua desplaçada.	Descrita sovint com a "l'estàndard d'or", és un dels mètodes més acceptats per a la mesura de l'adipositat total. Però el fet que requereixi haver d'aguantar la respiració sota l'aigua fa que sigui inadequat en certes poblacions como els nins. No és pràctic en estudis epidemiològics.
Desplaçament de l'aire per Pletismografia (*Air Displacement Plethysmography, ADP*) [6,54,70,125]	El volum del subjecte es mesura a partir del volum d'aire desplaçat dins d'una cambra tancada.	Medició ràpida i més tolerada. Els models més actuals, PEAPOD i BODPOD (Life measurement Inc., Concord, California, USA), tenen una alta fiabilitat per a determinar el %MG en nins i adults, respectivament. Però no és aplicable en nins molt petits ja que convé que respirin per un tub. En els ancians, hi ha una tendència a la sobreestimació de la MG per ADP en comparació amb DEXA.
Tomografia computeritzada (*Computerised Tomography, CT*) [6,54,70,125]	Es basa en la generació d'imatges de l'interior en successius talls axials de la regió del cos en estudi emprant raigs X. Els diferents teixits s'identifiquen segons la seva densitat, reflectida amb la seva opacitat als raigs X. Els petits depòsits de teixit adipós s'observen en les imatges, les quals es poden reconstruir tridimensionalment per a calcular el GC total i regional.	Permeten estimar el teixit adipós (distingint entre teixit adipós visceral i subcutani), el múscul esquelètic i altres òrgans i teixits. Però el cost és elevat. Inapropiat per a persones claustrofòbiques i nins, ja que han d'estar uns 20 min dins l'escàner. No és aplicable a persones de gran volum (IMC>40 kg/m^2) per la impossibilitat d'acomodar-les al seu interior i perquè el camp de visió de la majoria d'escàners és de 48x48 cm. En el cas de la CT, implica exposició a la radiació. L'aplicació està limitada a la investigació.
Imatge per ressonància magnètica (*Magnetic Resonance Imaging, MRI*) [6,54,70,125]	Una ressonància magnètica proporciona una imatge visual del teixit adipós i del teixit no adipós, permetent estimar el volum total de GC, la MG total i el %MG.	
Absorciometria de raigs X duals (*Dual-Energy X-ray Absorptiometry, DEXA*) [6,54,70]	Es basa en el principi que els raigs X transmesos en dos nivells d'energia són atenuats de manera diferent pel teixit mineral ossi i els teixits blans. El component dels teixits blans se subdivideix en MG i MLG a partir d'equacions derivades experimentalment.	Proporciona estimacions de 3 components: os, múscul i greix. És una tècnica no invasiva, aplicable a totes les edats. Bona precisió i reproducibilitat. Però tot i que baixa, hi ha exposició a la radiació. En estudis longitudinals on els individus estan sotmesos a canvis de composició corporal, les mesures de DEXA poden estar esbiaixades. Un estudi determinà que l'error de mesura de la MG en nins obesos fou menor que en nins no obesos; però l'error per la MLG fou major en els obesos.
Anàlisi de bioimpedància elèctrica (*Bioelectrical Impedance Analysis, BIA*) [6,54,70,125]	S'estima la proporció relativa a MLG i MG a partir de la resistència a una petita corrent que viatja a través dels fluids del cos. Es basa en què la corrent elèctrica passa més fàcilment a través dels fluids corporals en el múscul i la sang, però es troba amb una resistència quan passa per la grassa, ja que té un menor contingut en aigua.	Portabilitat, fàcil ús, cost relativament baix, ràpid, participació mínima per part dels subjectes i segura (no recomanant a persones amb marcapassos). La validesa està influenciada pel sexe, edat, presència de malaltia, ètnia, nivells de greix –el contingut total d'aigua corporal i d'aigua extracel·lular és major en individus obesos que en individus amb normopès- i tipus de sistema de BIA. Precisió i exactitud en l'estimació individual de la MG no superior als mètodes antropomètrics.
Tècniques de dilució [6,125]	Es basen en l'ús d'aigua marcada amb isòtopos estables (^{2}H, ^{18}O) administrats per via oral o endovenosa per a avaluar la MG i la MLG assumint que la hidratació de la MLG és estable.	L'administració del traçador i la recol·lecció de la mostra és senzilla. Elevat cost, personal expert i temps d'espera de vàries hores. No aplicable a estudis de gran escala i en nins molt petits.

Abreviatures: MG, massa grassa; MLG, massa lliure de grassa; IMC, índex de massa corporal.

Taula 2. Mètodes antropomètrics de determinació de la composició corporal.

Mètode	Descripció	Comentaris
Pes segons l'edat, Talla segons l'edat, Pes segons la talla [70,126]	Es basa en mesurar el pes i/o la talla i es compara amb taules de referència. S'han proposat diferents punts de talls per al sobrepès i l'obesitat: (i) un valor superior al 110% per al sobrepès i 120% per a l'obesitat de la mediana; (ii) una desviació estàndard o *Z score* de +1 per al sobrepès i +2 per a l'obesitat; (iii) altres sistemes de classificació empren percentils, com són el percentil 85 i 97 per a sobrepès i obesitat, respectivament.	El pes i la talla són fàcils de mesurar. Però les gràfiques de pes per talla són bastant imprecises, tant en la infància com en l'adolescència.
Índex de massa corporal (IMC) [70,126]	És una relació entre el pes (kg) i la talla (m^2). En nins i adolescents, es compara amb taules de referència	El pes i la talla són fàcils de mesurar. Alta especificitat per a l'excés de GC, especialment als nivells extrems [10,12,19]. Però baixa-moderada sensibilitat. Pot classificar erròniament persones amb un excés de GC però IMC baix o normal; i persones molt musculoses en tenir un IMC alt [10,12,19]. S'han descrit diferències racials o de grups ètnics en la relació entre IMC i GC [4,52,53]. Per a nins i adolescents existeixen diferents gràfiques de referència (nacionals i internacionals) i punts de tall.
Índex ponderal	És una relació entre el pes (kg) i la talla (m^3).	El pes i la talla són fàcils de mesurar. Però en els adolescents l'IMC és millor per a estimar el GC [9].
Circumferència de la cintura Relació cintura/maluc (ICM) Relació cintura/talla (ICT)	El perímetre de la cintura es mesura en el nivell més estret, per davall de la caixa toràcica (desena costella) i la cresta ilíaca [127]. El maluc es mesura es mesura en el nivell posterior màxim de la protuberància dels glutis [127].	Són fàcils de mesurar. Estimen el greix intraabdominal [10,125]. Són més sensibles a canvis al llarg del temps que l'IMC [67]. Encara no hi ha uns punts de tall internacionalment acceptats per a definir sobrepès i obesitat en nins i adolescents [125] .
Estudi de plecs cutanis [9,70,125,126].	Es mesuren diferents plecs cutanis (ex: tricipital, subescapular, etc) per a després comparar amb gràfiques de referència, o bé, estimar la MG total aplicant fórmules predictives adequades (ex: Mètode de Slaughter [69]).	Ràpid, baix cost i relativament simple per a mesurar GC. Es valora l'adipositat corporal mesurant la grassa subcutània (40-60% del total de la grassa corporal) [125]. De totes les mesures antropomètriques és la que té el nivell de precisió i exactitud inferior [127]. Per això, requereix d'entrenament per incrementar la fiabilitat i validesa intra- i interobservadors. En subjectes molt obesos pot ser no possible mesurar els plecs.

Abreviatures: MG, massa grassa; MLG, massa lliure de grassa; GC, greix corporal.

(ii) L'IMC i la MG estan fortament correlacionats, però no de manera suficient com per a fer deduccions útils a nivell individual [23] (Figura 1). Així per exemple, l'IMC per edat no és una eina precisa per a diagnosticar un excés de GC en el rang baix i mitjà de distribució de l'IMC [19,25]. És a dir, hi ha nins i adolescents amb un IMC "normal" però amb un excés de GC que no són identificats com a individus obesos (falsos negatius en el diagnòstic de l'obesitat) [19,24,25]. I de fet, en els adults amb normopès però amb un excés de GC s'ha observat un perfil lipídic i inflamatori desfavorable, l'anomenat «síndrome del normopès-obès» [26]. Per altra banda, nins i adolescents molt musculosos també podrien ser classificats erròniament com a obesos en tenir un IMC per edat alt (falsos positius en el diagnòstic de l'obesitat) [19,24,25]. Però hi ha revisions en la literatura que confirmen que l'IMC per edat identifica els nins i adolescents amb obesitat amb una especificitat alta, és a dir, identifica un nombre baix de falsos positius (individus que no tenen un excés de GC o no-obesos) [10,12,19]. I és que a nivells molt alts d'IMC, la majoria de nins i adolescents presenten un excés de GC [19,25,27]. A més, també s'ha observat que els punts de tall d'IMC per edat per a definir obesitat identifiquen amb una alta especificitat els nins i adolescents amb factors de risc per a malalties cardiovasculars i metabòliques [28].

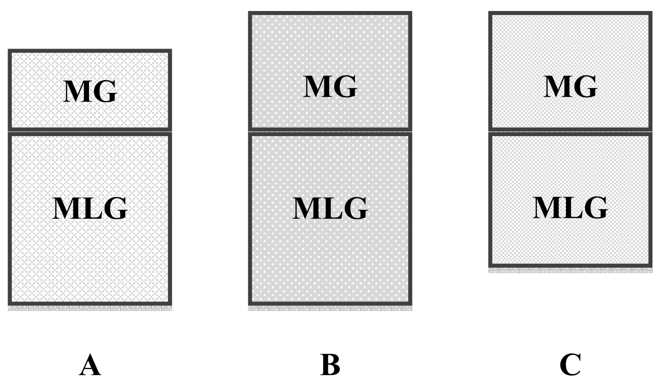

Figura 1. Composició corporal en tres adolescents hipotètics amb idèntica talla. El percentatge de greix corporal és major en B que en A a causa d'una major massa grassa (MG), però major en C que en B a causa d'una menor massa lliure de grassa (MLG) [128].

Malgrat això, l'IMC per edat identifica els nins i adolescents amb obesitat amb una sensibilitat baixa-moderada (tot i que aquesta magnitud depèn del punt de tall emprat [12,19,25]), és a dir, identifica un nombre moderat de falsos negatius (individus que tenen un excés de GC) [10,12,19,29]. A més, els punts de tall d'IMC per edat per a definir obesitat en nins i adolescents també identifica els nins i adolescents amb factors de risc per a malalties cardiovasculars i metabòliques amb una sensibilitat baixa-moderada [28].

La sensibilitat baixa-moderada de l'IMC per a identificar els nins que presenten excés de GC és un problema. I és que encara que part d'aquests nins són recuperats a la categoria de sobrepès –a excepció dels que tenen un IMC dins la categoria de normopès però que presenten un excés de GC-, els nins i adolescents que tenen un sobrepès per IMC no necessàriament tenen complicacions clíniques o risc de salut relacionats amb un excés de GC [30]. I és que el punt de tall d'IMC per edat per a definir sobrepès té una especificitat i una sensibilitat moderades [28]. A més, també és interessant tenir present que l'especificitat amb què el punt de tall de l'IMC per edat per a definir sobrepès identifica els nins i adolescents amb un excés de GC difereix entre els dos sexes, essent major als al·lots que a les al·lotes [31].

(iii) L'extensió dels riscs de salut no es refereixen exclusivament a un total de MG i està més relacionada amb la massa grassa intraabdominal o visceral [23]. La MG intraabdominal incrementa el risc de diabetis, hipertensió i malalties cardiovasculars [24], però ni l'IMC ni la MG es correlacionen bé amb la MG visceral o els factors de risc cardiovasculars [23].

Les gràfiques d'IMC

En general, tots els criteris per a definir el sobrepès i l'obesitat en els nins i els adolescents coincideixen en un ajustament per sexe i edat, adaptant-se a la situació dinàmica de creixement durant aquestes etapes. Es tracta de gràfiques de creixement (*growth charts*) confeccionades a partir d'una població de referència que representa en percentils la distribució dels nins i adolescents en funció de la seva edat i sexe per al paràmetre mesurat (pes, talla, IMC, perímetres -cefàlic, braquial, cintura, maluc…-, plecs cutanis, etc). Amb aquests gràfics es pot determinar el percentatge de nins que es troben per damunt i per davall del punt de tall d'interès, mesurat a una edat i sexe [13,32-38].

Ara bé, tant els clínics com els investigadors ens trobam amb una sèrie de dificultats a l'hora d'identificar si un nin o adolescent té sobrepès i obesitat a partir de les gràfiques d'IMC. I és que: "(i) Quina gràfica d'IMC de referència hem d'emprar?", "(ii) És millor emprar gràfiques de referència nacionals o internacionals?" i "(iii) Quins punts de tall hem d'aplicar per a delimitar el sobrepès i l'obesitat?" [39] són algunes preguntes que segurament clínics i investigadors s'hauran plantejat en alguna ocasió, però de moment cap d'elles té una resposta simple.

(i) Quina gràfica d'IMC de referència hem d'emprar?

Hi ha una gran varietat de gràfiques de creixement. És més, hi ha gràfiques de referència internacional i de referència nacional, i inclús algunes de regionals o locals, però no hi ha un consens en quina gràfica és més convenient emprar.

(i.1) *Gràfiques d'IMC de referència nacional.* Molts països han desenvolupat les seves pròpies gràfiques emprant com a referència les dades de la seva població. Així per exemple, a Espanya existeixen dues gràfiques de base poblacional nacional: la gràfica elaborada a partir de l'estudi enKid l'any 2002 [35,36] i la publicada per Carrascosa l'any 2008 [40]. A més, a Espanya també existeixen una sèrie de gràfiques de base regional [37,38,41-46].

(i.2) Gràfiques d'IMC de referència internacional o d'ús generalitzat. Les primeres gràfiques d'IMC emprades de forma generalitzada foren les publicades per Must et al. [47,48] l'any 1991. Aquestes gràfiques foren realitzades per la *National Center for Health Statistics* (NCHS) a partir de l'enquesta nacional de salut i nutrició dirigida a la població nord-americana entre els 6 i 74 anys, la *National Health and Nutrition Survey* (NHANES-I). En moltes ocasions, aquestes gràfiques apareixen citades en la literatura com a NCHS/OMS, i és que un Comitè d'Experts de l'OMS reunit el 1993, recomanà el seu ús en els adolescents, tot i que de manera provisional, ja que les dades d'IMC procedents dels adolescents nord-americans no tenien una aplicació internacional [16,49]. Aquest mateix Comitè d'Experts de l'OMS també recomanava que en estudis epidemiològics s'informés no només de les freqüències d'IMC per grup d'edat d'acord a la referència d'IMC recomanada, sinó també els adolescents amb un IMC≥30 kg/m^2 per edat, en considerar que aquest punt de tall proporciona continuïtat amb la definició d'obesitat en l'adult [16].

L'any 2000, la NCHS proporcionà unes noves gràfiques de creixement, les *Centers for Disease Control and Prevention (CDC) growth charts* [33], amb les quals es pretenia solucionar una sèrie de problemes derivats d'errades tècniques i limitacions biològiques de les gràfiques anteriors [16,50]. Aquestes gràfiques foren realitzades a partir de les dades de 5 enquestes nacionals de salut desenvolupades entre els anys 1963 i 1994. Però una vegada més, aquestes gràfiques –emprades en la majoria dels estudis de prevalença de l'àmbit d'influència nord-americana-, no són internacionalment representatives, podent donar lloc a interpretacions errònies si s'empren com a referència a altres països.

D'aquesta manera, es podria dir que actualment es disposen només de dues gràfiques de creixement d'IMC amb base poblacional internacional que inclouen l'etapa adolescent: (1)

les gràfiques de creixement de Cole et al. [13], proposades per la *International Obesity Task Force* (IOTF); i (2) les gràfiques de creixement per a nins i adolescents de 5 a 19 anys proporcionades per l'OMS i publicades el 2007 [34].

(i.2.1) Gràfiques d'IMC internacionals de Cole et al. [13] i proposades per la IOTF (criteris IOTF). Cole et al. [13] varen elaborar unes gràfiques d'IMC en una població internacional (97876 al·lots i 94851 al·lotes) a partir de les dades de 6 estudis transversals amb mostres representatives d'un total de sis països i ciutats (Brasil, Gran Bretanya, Hong Kong, Holanda, Singapur i EEUU). Aquestes gràfiques defineixen el sobrepès i l'obesitat per a cada edat i sexe, no a partir d'un percentil determinat, sinó a partir del valor percentil que es correspon amb els punts de tall d'IMC que l'OMS va establir per a la població adulta (a partir dels 18 anys): IMC≥25 kg/m^2 pel sobrepès, i IMC≥30 kg/m^2 per l'obesitat [16].

(i.2.2) Gràfiques d'IMC internacionals proposades per l'OMS l'any 2007. L'any 2007, l'OMS va publicar unes noves gràfiques de creixement que abastaven el període infantil i adolescent (de 5 a 19 anys) [34] i que reemplaçaren a les gràfiques que prèviament havia recomanat per a edats compreses entre els 9 i 24 anys (NCHS/OMS, 1991) [16]. La mostra bàsica per a la construcció de les noves gràfiques de creixement fou la mateixa que l'emprada per a la construcció de les gràfiques originals, NCHS/OMS de 1977, però completada amb dades procedents dels Patrons de Creixement Infantil de l'OMS publicats l'any 2006 [32], ja que un dels objectius principals d'aquestes gràfiques era obtenir una transició uniforme des de l'etapa preescolar (de 0 a 5 anys) a l'etapa escolar [34]. La mostra final emprada per a l'obtenció de les gràfiques d'IMC fou de 30,018 subjectes (15103 nins i 14915 nines). El resultat foren gràfiques i taules de percentils i de puntuacions *z* des del percentil 1 fins el 99, i des de valors de la desviació estàndard (DE) de -3 a +3 [34]. Els valors d'IMC corresponents a +1DE, +2DE i +3DE de la mesura es corresponen amb els punts de tall establerts per a sobrepès, obesitat i obesitat severa, respectivament.

(ii) És millor emprar gràfiques de creixement nacionals o internacionals?

L'elecció de la gràfica de creixement de referència és determinant en un estudi epidemiològic, ja que un mateix nin o adolescent amb un IMC, sexe i edat concrets pot ser classificat com a obès o no en funció de la referència emprada. En conseqüència, la prevalença del sobrepès i l'obesitat en una mateixa població pot variar de 2 a 7 vegades dependent de si la gràfica de referència és de base poblacional nacional o internacional [4].

A la literatura hi ha nombrosos estudis que comparen l'habilitat de les gràfiques nacionals i internacionals, principalment els criteris IOTF, en la definició de sobrepès i obesitat. Una revisió sistemàtica recentment realitzada per Reilly et al. [19] dóna suport a la recomanació d'emprar les gràfiques d'IMC nacionals enfront als criteris IOTF, ja que en analitzar l'habilitat de l'IMC per edat per a identificar els participants amb excés de GC en un total de 8 estudis, Reilly i els seus col·laboradors observaren que en 5 dels estudis revisats la sensibilitat de l'IMC amb referències nacionals era significativament superior que quan s'empraven els criteris IOTF, mentre que l'especificitat era similar en 7 dels estudis. Per altra banda, estudis de comparació entre diferents grups ètnics-racials indiquen que les comparacions dels nivells de sobrepès i obesitat s'haurien de fer en quant a adipositat i no en quant a IMC [4,51], i en cas d'emprar l'IMC convindria un ajustament de les gràfiques a les poblacions o grups d'ètnies específics [19,52,53]. I és que certes poblacions semblen tenir, per un IMC donat, un major contingut de GC i una major distribució del greix a l'abdomen (patró de distribució del greix associat amb trastorns metabòlics i cardiovasculars) [4]. En conseqüència, aquestes mateixes poblacions podrien tenir un major risc d'algunes comorbiditats de l'obesitat [4,54].

Ara bé, les gràfiques de referència internacional faciliten la comparabilitat, encara que s'han de considerar amb precaució [4] i només per a la projecció del sobrepès i l'obesitat [55]. I és que fins i tot l'ús dels criteris IOTF i els estàndards de l'OMS en una mateixa mostra proporcionen prevalences molt diferents [15,56].

Per tant, en estudis epidemiològics cada vegada està més assumida la importància d'emprar gràfiques d'IMC de referència internacional que facilitin la comparació [39] essent els criteris IOTF els més emprats actualment. En canvi, en el diagnòstic clínic és més freqüent trobar recomanacions de l'ús de gràfiques d'IMC nacionals [57-59], associat a la història clínica i a un indicador addicional d'adipositat corporal, com els plecs tricipitals i subescapulars com recomana l'OMS [16] o la valoració antropomètrica de la composició corporal com recomana l'Associació Espanyola de Pediatria (AEP) [60].

(iii) Quins punts de tall hem d'aplicar per a delimitar el sobrepès i l'obesitat?

Així com no hi ha un consens en quina gràfica d'IMC és més convenient emprar, tampoc hi ha un consens en els punts de tall a aplicar (Taula 3). Així, per exemple, en el Regne Unit els percentils 91 i 98 de les seves pròpies gràfiques d'IMC segons edat i sexe (UK 1990 *growth charts*) són emprats en la pràctica clínica per a definir sobrepès i obesitat, respectivament [57,58]. Als EEUU, els percentils 85 i 95 de les gràfiques CDC segons l'edat i el sexe defineixen el sobrepès i l'obesitat, respectivament; i el percentil 99 ha estat recomanat per a definir obesitat extrema [14]. En general, a la població espanyola s'ha considerat diagnòstic de sobrepès si l'IMC es troba per damunt del percentil 85 i obesitat si l'IMC és superior al percentil 95 de la mateixa edat i sexe; però en altres ocasions també s'han elegit els percentils 90 i 97 per a definir sobrepès i obesitat, respectivament [20].

Taula 3. Gràfiques d'IMC i els corresponents percentils d'IMC per edat i sexe emprats per a definir sobrepès i obesitat en els adolescents

Gràfica d'IMC	Sobrepès	Obesitat
NCHS/OMS (ús internacional) [16,47,48]	≥85	≥95
IOTF (ús internacional) [13]	Percentil equivalent a l'IMC 25 kg/m^2 en els adults	Percentil equivalent a l'IMC 30 kg/m^2 en els adults
OMS 2007 [34]	+1DE	+2DE
CDC 2000 (ús als EEUU, internacional) [33]	≥85 (*en risc de sobrepès*)	≥95 (*sobrepès*)
UK 1990 growth charts (ús al Regne Unit) [130]	>91	>98
Hernández et al., 1988[a] (ús a Espanya) [37]	≥90	≥97
Sobradillo et al., 2004 (ús a Espanya) [38]	≥85	≥95

Abreviatures: IMC, índex de massa corporal; NCHS, *National Center for Health Statistics*; OMS, Organització Mundial de la Salut; IOTF, *International Obesity Task Force*; CDC, *Centers for Disease Control and Prevention*; UK, *United Kingdom*; DE, desviació estàndar.
[a]En l'estudi enKid (1998-2000) [35] es varen emprar els punts de tall P85 i P97 per a definir sobrepès i obesitat, respectivament.

S'ha postulat que la definició ideal de sobrepès i obesitat hauria d'estar altament correlacionada amb indicadors de futur risc cardiovascular i malaltia metabòlica o en la seva habilitat de predir futurs problemes de salut [23]. Però no es coneix quin és el nivell de sobrepès i obesitat en nins i adolescents que es relaciona amb aquests riscs [25], motiu pel qual els punts de tall són arbitraris. A més, pel fet que per un IMC donat hi ha poblacions o grups d'ètnies que tenen un major GC i major distribució de greix abdominal, en algunes poblacions d'adults ja s'han definit punts de tall específics. I s'ha postulat que aquests punts de tall específics per a poblacions també podrien ser necessaris en nins i adolescents [25]. I és que encara que amb l'ús del percentil 95, fins i tot els percentils extrems com el 97 ó 98, per a definir l'obesitat s'aconsegueix deixar pocs falsos positius, és a dir, s'evita classificar com a obesos nins i adolescents que poden no ésser-ho, hi ha evidències que es necessiten més investigacions per a obtenir una definició o un diagnòstic òptim de sobrepès en nins i adolescents [25].

En resum... Hi ha moltes definicions de sobrepès i obesitat infanto-juvenil a partir de l'IMC, i cada definició empra una corba de percentils de referència i/o uns percentils per a definir els punts de tall per al sobrepès i l'obesitat diferents. Donada la gran varietat de criteris per al diagnòstic de sobrepès i obesitat, és precís establir un consens que faciliti estudis epidemiològics comparatius [25,56]. En aquest sentit, els criteris IOTF s'han proposat com una eina inicial vàlida de contrast poblacional [25,56] i a nivell individual, ja que en estar basats en la definició de sobrepès i obesitat als 18 anys estan basats en una associació amb posteriors problemes de salut [56]. Malgrat això, els criteris IOTF tenen tendència a subestimar l'obesitat i sobreestimar el sobrepès [12,15,19,25], de manera que en la pràctica clínica certs individus amb un important excés de greix podrien no diagnosticar-se com a obesos i quedar exclosos de programes de tractament [25].

1.2.2.2. El perímetre de la cintura

El perímetre de la cintura és un marcador indirecte de l'obesitat intraabdominal [10] (una suma del greix abdominal i subcutani a aquest nivell) [61], el qual és conegut com el més patogènic [10]. Els adults amb un gran perímetre de cintura presenten major risc de malalties metabòliques i cardiovasculars, així com més mal d'esquena [19]. En nins i adolescents, també sembla haver-hi evidències de risc de salut associat amb un excés de greix intraabdominal [61-63]. De fet, Moreno et al. [64] han indicat que el perímetre de la cintura és un dels determinants del síndrome metabòlic (SMet) més important en els nins i adolescents. Però així com a la literatura es poden trobar estudis que suggereixen avantatges en l'ús del perímetre de la cintura enfront a l'IMC, altres indiquen que no hi ha evidències en què s'hagi d'emprar com a preferent per al diagnòstic d'un excés de GC en nins i adolescents [19,65,66].

El perímetre de la cintura s'ha establert com a un mètode útil per al diagnòstic del sobrepès i l'obesitat en adults [19] amb la finalitat de millorar l'estimació de la presència de riscs associats a l'obesitat [10]. El seu ús també s'ha incrementat en nins i adolescents [19], i també podria tenir algunes aplicacions útils com a marcador addicional. I és que també s'ha vist que el perímetre de la cintura pot aportar informació addicional a la que aporta l'IMC en ser especialment adequat per a detectar petits canvis en la població infantil i adolescent al llarg del temps [19,67]. Així, per exemple, un estudi realitzat al Regne Unit va observar que la tendència en la distribució del greix intraabdominal fou més pronunciada que en el cas de l'IMC, suggerint així que les conseqüències cardiovasculars i metabòliques de l'epidèmia podrien ser subestimades emprant l'IMC per a analitzar tendències [67].

1.2.2.3. Els plecs cutanis

Els plecs cutanis mesuren el greix subcutani en diverses parts del cos, encara que els més comuns són els plecs del tríceps i el subescapular [9]. Es tracta d'una mesura econòmica i relativament fàcil [9] que s'ha emprat tant en els estudis epidemiològics com clínics, i tant a nivell poblacional com individual [68]. I és que els plecs cutanis es correlacionen bé amb el GC (40-60% del GC pot ser mesurat directament amb un lipocalímetre [68]), tot i que s'ha de tenir en compte que el GC depèn de l'edat i el sexe [9]. Ara bé, cal fer notar que la reproducibilitat i fiabilitat de la mesura s'augmenta amb l'ús d'una metodologia estandarditzada [68]. Per altra banda, la predicció de la MG corporal a través dels plecs cutanis es realitza aplicant equacions. Hi ha vàries equacions per a predir la MG corporal a partir dels plecs cutanis, però Rodríguez et al. [68] han recomanat l'ús preferencial de l'equació de Slaughter et al. [69] en els adolescents.

1.3. Controvèrsies en la terminologia

La terminologia emprada en els estudis epidemiològics varia considerablement [30]. En alguns estudis es parla de "sobrepès" i "obesitat", mentre que en altres s'utilitza "en risc de sobrepès" i "sobrepès". I és que "sobrepès" i "obesitat" s'ha emprat indistintament en moltes ocasions, tot i no ser termes idèntics [51]. Així per exemple, en els EEUU per tal d'evitar la connotació pejorativa de la paraula "obesitat" en el nin i l'adolescent, la terminologia antiga definia el sobrepès com a "en risc de sobrepès" i l'obesitat com a "sobrepès" [51]. I, de cada vegada és més freqüent en les publicacions la utilització de termes com a "excés de pes" per a referir-se conjuntament als nins i adolescents amb sobrepès i obesitat. Aleshores, cal fer notar que la definició que s'estigui emprant en cada estudi és important, sobretot quan es comparen estimacions de diferents estudis [51].

2. MAGNITUD DEL PROBLEMA

2.1. Prevalença i tendències del sobrepès i l'obesitat juvenil

Com han indicat Lobstein et al. [70]: «El nostre coneixement sobre l'obesitat global en nins i adolescents és limitat a causa de l'absència de dades representatives comparables i, en particular, a causa de la gran varietat de criteris per a definir l'obesitat entre els diferents països i investigadors». I és que la comparació de la prevalença de sobrepès i obesitat s'ha de realitzar amb precaució, ja que tot i que la classificació del sobrepès i l'obesitat infanto-juvenil és el principal obstacle a l'hora d'estudiar la tendència global en nins i adolescents [70], també s'han de tenir en compte les diferències metodològiques com són la mida de la població [71], l'àmbit geogràfic (estudis nacionals, regionals o locals), el tipus de població estudiada (general, escolar o sanitària), el rang d'edat dels subjectes [71], la qualitat de les dades en quant al pes i la talla (autoreferits o mesurats per part dels investigadors) [71], així com l'existència de programes o estratègies per a prevenir el sobrepès i l'obesitat en el lloc d'estudi [71]. A més, en un mateix país la prevalença i la tendència del sobrepès i l'obesitat pot ser no homogènia i estar relacionada amb el grup ètnic, la regió geogràfica i el nivell socioeconòmic [71]. Per altra banda, es tracta d'un problema de salut no estabilitzat i amb tendència a incrementar, fet que també dificulta la comparació dels estudis.

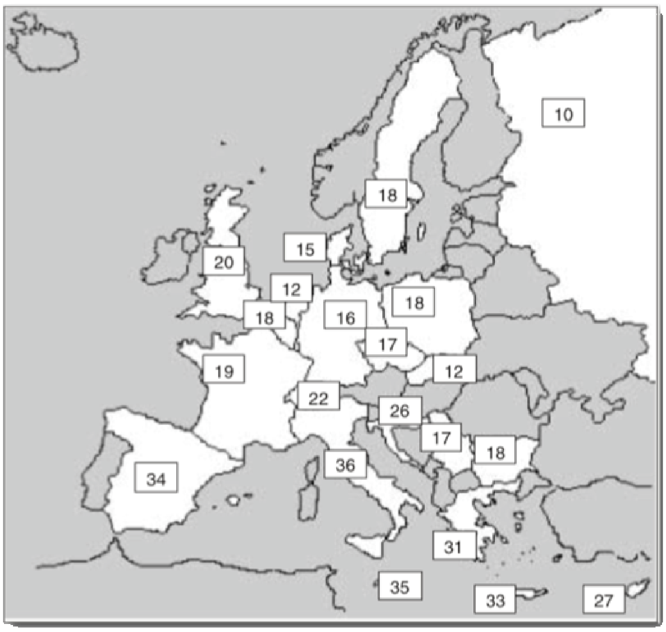

Figura 2. Prevalença (%) de sobrepès en nins (7-10 anys) de diversos països d'Europa. El sobrepès està definit segons el criteri IOTF i inclou obesitat. Basat en enquestes de després de l'any 1990. Font: Lobstein T, Baur L, Uauy R, IASO International Task Force. Obesity in children and young people: a crisis in public health. *Obes Rev* 2004;5(Supl.1):4–85.

2.1.1. Prevalença del sobrepès i l'obesitat juvenil a nivell internacional

L'obesitat infanto-juvenil és un dels problemes de salut pública més greus del segle XXI. La prevalença de sobrepès i obesitat ha augmentat de manera alarmant en els darrers anys i està afectant tant als països desenvolupats com als països en vies de desenvolupament [1]. De fet, en la major part del món l'obesitat és la malaltia pediàtrica més freqüent, i fins i tot, en alguns països en vies de desenvolupament ha sobrepassat la prevalença de baix pes [4]. Les excepcions de països on l'obesitat és un problema són poques, com el sud-Sàhara, Àfrica i la major part de l'ex- Unió Soviètica, on les dificultats econòmiques extremes han limitat l'epidèmia [4].

L'any 2004, d'acord amb els criteris IOTF, es va estimar que aproximadament el 10% de la població infanto-juvenil (dels 5 als 17 anys) tenia sobrepès i el 2-3% obesitat [70]. Però cal tenir en compte que la prevalença variava considerablement entre els diferents països i les diferents regions, des de <5% a Àfrica i algunes parts d'Àsia, a un 20% a Europa (Figura 2) i >30% a Amèrica i alguns països de l'Orient Mitjà [70]. Posteriorment, Wang i Lobstein [72] estimaren la prevalença de sobrepès i obesitat en la població infanto-juvenil d'acord als criteris IOTF per als anys 2006 i 2010. A la taula 4 es recull la projecció que obtingueren a partir de la revisió d'estudis realitzats entre el 1980 i el 2005 en població en edat escolar (25 països) i preescolar (42 països). Per altra banda, també cal fer notar que l'OMS estima que en el 2015 hi haurà 2.3 bilions de persones de ≥15 anys amb sobrepès, i més de 700 milions d'obesos [18].

També cal fer notar que en la darrera dècada s'han publicat nombrosos estudis de diferents països que analitzen la prevalença de sobrepès i obesitat juvenil (de 10 a 19 anys) a nivell nacional. A la taula 5 es recullen les dades dels estudis més representatius.

Taula 4. Prevalença (%) de sobrepès i obesitat estimada per a l'any 2006 i 2010

Regió (dades d'enquestes emprades)	Projecció 2006		Projecció 2010	
	Sobrepès (%)	Obesitat (%)	Sobrepès (%)	Obesitat (%)
Àfrica (1987-2003)	*	*	*	*
Amèrica (1988-2002)	16.8	13.2	31.2	15.2
Est del Mediterrani (1992-2001)	25.9	9.4	30.2	11.5
Europa (1992-2003)	23.9	7.9	28.2	10.0
Sud-Est d'Àsia (1997-2002)	13.3	3.3	17.6	5.3
Oest del Pacífic (1993-2000)	15.8	5.0	20.2	7.0

*Les dades foren insuficients en la població escolar com per a poder fer una projecció de la prevalença del sobrepès i l'obesitat. Font: Wang Y & Lobstein T. Worldwide trends in childhood overweight and obesity. *Int J Obes* 2006;1:11-25.

Taula 5. Prevalença (%) de sobrepès i obesitat en adolescents (10 a 19 anys). Estudis nacionals publicats en la darrera dècada

Continent	*País*	*Any de l'estudi*	*Població d'estudi*	*Edat (anys)/ Grau escolar*	*Criteri*	Sobrepès (%)			Obesitat (%)			Referència
						Total	*Al·lots*	*Al·lotes*	*Total*	*Al·lots*	*Al·lotes*	
ÀFRICA	Seychelles	2004	Estudi població escolar	7è,10è	IOTF[1]	12.0	9.5	14.3	5.1	4.2	6.0	[130]
	Sud Àfrica	2008	2008 SA YRBS	13-19	IOTF[1]	14.4	7.9	20.6	5.3	3.3	7.2	[131]
	Tunísia	2004	Estudi població general	15-19	IOTF[1]	12.4	11.0	14.1	2.6	1.9	3.2	[132]
AMÈRICA	Canada	2004	2004 CCHS	12-17	IOTF[1]	19.8	21.2	18.4	9.4	11.1	7.4	[133]
					CDC[2]	15.9	17.0	14.7	12.1	14.3	9.6	
					OMS[3]	20.8	21.9	19.6	12.4	15.1	9.4	
	Mèxic	2006	Estudi població general	12-18	IOTF[1]	21.2	20.1	22.3	8.9	9.2	8.6	[134]
	EEUU	2007	2007 NSCH	10-17	CDC[2]	15.2	15.3	15.2	16.4	19.2	13.5	[135]
ÀSIA	Bahrain	2000	Estudi població escolar	12-17	IOTF[1]	20.0	15.3	24.5	16.4	14.9	17.9	[136]
	Xina	2002	2002 CNNHS	13-17	IOTF[1]	4.6	4.6	4.6	0.6	0.7	0.5	[137]
	Iran	2003-04	CASPIAN Study	10-18	IOTF[1]	5.9	5.7	6.0	1.3	1.5	1.1	[138]
					CDC[2]	4.5	4.3	4.7	1.9	2.3	1.6	
	Israel	2003-04	MABAT Youth Survey	11-19	CDC[2]	12.9	12.7	13.0	5.6	7.4	4.1	[139]
	Qatar	2003-04	Estudi població escolar	12-17	IOTF[1]	23.8	28.6	18.9	6.3	7.9	4.7	[140]
	Aràbia Saudí	2005	Estudi població general	13-18	CDC[2]	17.9	16.5	19.6	7.0	8.2	5.5	[141]
					OMS[3]	16.0	13.6	18.4	10.6	11.2	10.0	
	Taiwan	2003	Estudi població escolar	10-18	IOTF[1]	16.3	18.4	14.2	6.2	8.1	4.2	[142]
EUROPA	Xipre	1999-2000	Estudi població escolar	10-17	IOTF[1]	18.9	21.3	16.5	5.8	7.1	4.5	[143]
	República Txeca	2005	Lifestyle and Obesity Study	6-17	IOTF[1]	12.3	16.6	8.0	1.4	1.7	1.0	[144]
	Alemanya	2008	CrescNet database	12-16	IOTF[1]	18.2	19.3	17.0	6.2	7.6	4.6	[145]
	Grècia	2003	Estudi població escolar	13-19	IOTF[1]	18.3	23.3	14.0	4.3	6.1	2.7	[146]
	Itàlia	2002	HBSC Study	11,13,15	IOTF[1]	15.6	20.9	10.6	2.3	3.5	1.2	[147]
	República d'Irlanda	2003	Estudi població escolar	11-16	IOTF[1]	18.5	17.8	19.2	5.8	5.6	6.1	[148]
	Nord d'Irlanda	2003	Estudi població escolar	11-15	IOTF[1]	18.2	18.5	17.8	5.9	6.0	5.7	[148]
	Portugal	2008	Estudi població escolar	10-18	IOTF[1]	17.4	17.7	17.0	5.2	5.8	4.6	[149]
					OMS	21.8	20.4	23.1	9.9	10.3	9.6	
	Suècia	2001	Estudi població escolar	10,13,16	IOTF[1]	15.8	14.6	16.9	4.4	5.0	3.6	[150]
OCEANIA	Austràlia	2004	2004 SPANS	8è,10è	IOTF[1]	17.9	19.4	16.2	5.3	6.7	3.6	[151]
	Nova Zelanda	2007	Youth'07 Survey	13-17	IOTF[1]	24.0	23.3	24.7	10.2	10.8	9.5	[152]
					OMS	25.9	25.9	26.0	13.5	14.6	12.1	

Abreviatures: IOTF, *International Obesity Task Force*; CDC, *Center for Disease Control and Prevention*; OMS, Organització Mundial de la Salut; 2008 *SA YRBS, 2008 South African National Youth Risk Behaviour*; 2004 CCHS, *2004 Canadian Community Health Survey*; 2007 NSCH, *2007 National Survey of Children's Health*; 2002 CNNHS, *2002 China National Nutrition and Health Survey*; CASPIAN Study, *Childhood and Adolescence Surveillance and Prevention of Adult Non-communicable disease Study*; HBSC, *Health Behaviour in School-aged Children;* 2004 SPANS, *2004 NSW Schools Physical Activity and Nutrition Survey*.
Criteris de definició del sobrepès i l'obesitat: [1]Sobrepès, IMC per edat i sexe ≥25 kg/m^2 i obesitat, IMC per edat i sexe ≥30 kg/m^2 de les gràfiques IOTF [13]; [2]Sobrepès, IMC≥P85-<P95 i obesitat, IMC≥P95 per edat i sexe de les gràfiques CDC 2000 [33]; [3]Sobrepès: IMC per edat i sexe >+1DE i <+2DE, obesitat: >+2DE de les gràfiques de l'OMS publicades el 2007 [34].

2.1.2. Prevalença del sobrepès i l'obesitat juvenil a Espanya

A Espanya, només existeix un estudi epidemiològic a nivell nacional que tracta el problema de l'obesitat juvenil: l'estudi enKid [35], que avaluà els hàbits alimentaris i l'estat nutricional de tota la població infanto-juvenil espanyola (*n* = 3534) compresa entre els 2 i els 24 anys i es va realitzar entre els anys 1998 i 2000. Per a facilitar la comparació dels resultats, es va definir el sobrepès i l'obesitat emprant distintes gràfiques de creixement d'IMC: la referència nacional publicada per Hernández et al. [37] i els estàndards d'ús generalitzat CDC i IOTF (Taula 6). Aquest estudi també va relacionar la prevalença de sobrepès i obesitat amb els factors socioeconòmics i sociodemogràfics, subratllant una variabilitat geogràfica. Així, s'indicà que la prevalença de sobrepès i obesitat infanto-juvenil era més elevada a Canàries i Andalusia i més baixes en el nord-est peninsular (Figures 3A i B).

L'estudi SEEDO 2000 també va descriure un patró de distribució geogràfica similar en els adults espanyols (25 a 60 anys), amb una prevalença d'obesitat més elevada a Galícia, Andalusia i a les Illes Canàries [73]. Per altra banda, cal fer notar que a Europa també s'ha descrit un gradient en la prevalença de l'excés de pes (sobrepès + obesitat) en nins de 7 a 10 anys, essent major en el sud d'Europa (20-35%) i menor en el nord (10-20%) (Figura 2) [70]. Tot i que el motiu d'aquest gradient nord-sud no està clar [70].

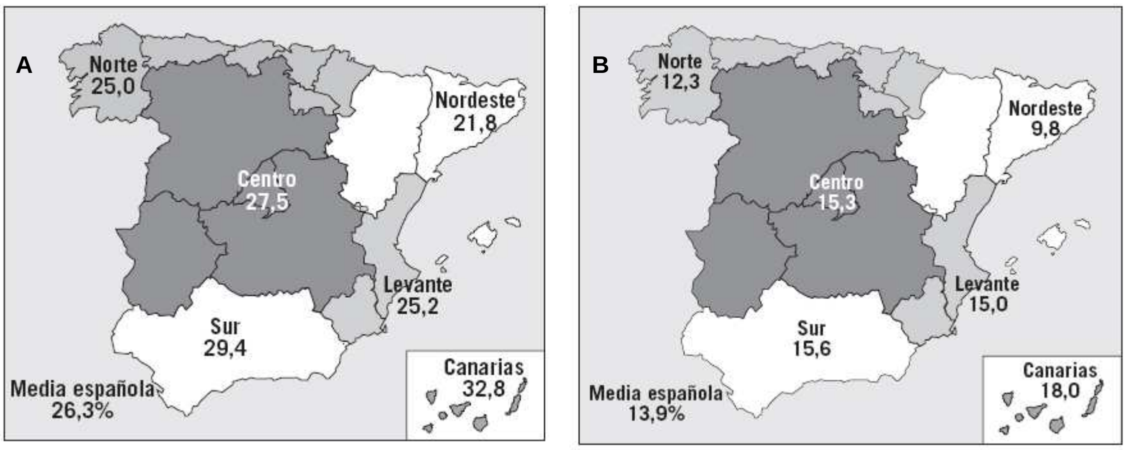

Figura 3. (A) Prevalença (%) d'excés de pes (sobrepès + obesitat) en la població de 2 a 24 anys per regions. **(B)** Prevalença d'obesitat en la població de 2 a 24 anys per regions. Estudi enKid, 1998-2000. Valors de referència: percentil 85 per a l'excés de pes, i percentil 97 per a l'obesitat de les gràfiques d'Hernández et al. [37]. Font: Serra Majem Ll et al. Obesidad infantil y juvenil en España. Resultados del Estudio enKid (1998-2000). *Med Clin (Barc)* 2003;121(19):725–732.

Taula 6. Prevalença de sobrepès i obesitat entre els adolescents espanyols de 10 a 17 anys, Estudi enKid, 1998-2000.

			Sobrepès (%)			Obesitat (%)		
	Edat (anys)	*n*	IOTF	CDC[1]	Hernández et al.[1]	IOTF	CDC[1]	Hernández et al.[1]
Total	10 a 17	1249	18.4	14.4	11.6	5.8	8.0	14.2
	10 a 13	567	22.2	17.4	14.5	4.6	8.9	16.4
	14 a 17	682	15.2	12.0	9.1	6.4	7.3	12.4
Al·lots	10 a 17	618	23.2	18.1	14.7	8.5	12.5	18.6
	10 a 13	281	26.1	22.1	20.0	6.6	13.0	21.9
	14 a 17	337	20.7	14.8	10.3	10.0	12.0	15.8
Al·lotes	10 a 17	631	13.7	10.8	8.5	2.7	3.7	9.9
	10 a 13	286	18.4	12.7	9.1	2.6	4.9	10.9
	14 a 17	345	9.8	9.3	8.0	2.8	2.7	9.1

Abreviatures: IOTF, *International Obesity Task Force*; CDC, *Centers for Disease Control and Prevention.*
[1]Sobrepès definit com a IMC≥P85 i <P95, i obesitat com a IMC≥P95 per a edat i sexe. Font: Serra Majem L et al. Epidemiología de la obesidad infantil y juvenil en España. Resultados del estudio enKid (1998-2000). En: Serra Majem L, Aranceta Bartrina J, editors. Obesidad Infantil y Juvenil. Estudio enKid. Vol 2. Barcelona: Masson. 2001:p.81–108.

Les dades més recents de sobrepès i obesitat juvenil a Espanya provenen de la darrera Enquesta Nacional de Salut (ENS) realitzada per al Ministeri de Sanitat, Política Social i Igualtat l'any 2006 [74]. L'ENS 2006 indicà una prevalença de sobrepès i obesitat del 20% i 5.1% entre els adolescents de 10 a 14 anys, i del 17% i 2.2% entre els adolescents de 15 a 17 anys, respectivament. Igual que en l'estudi enKid, les dades de l'ENS 2006 indiquen una variabilitat geogràfica en la prevalença de sobrepès i obesitat infanto-juvenil (de 2 a 17 anys). Així, la prevalença global de sobrepès i obesitat fou >30% en Andalusia, Canàries i Múrcia, però també a La Rioja (Taula 7). Per altra banda, de la comparació de la prevalença de sobrepès i obesitat de l'ENS 2006 amb l'enquesta realitzada anteriorment i que també analitza la població infanto-juvenil, l'ENS 2003 [75], es confirma la tendència creixent del sobrepès i l'obesitat en els adolescents espanyols (Taula 8).

A Espanya, a part de l'estudi enKid i de les ENS 2003 i 2006, en la darrera dècada també s'han publicat una sèrie d'estudis que analitzen la prevalença de sobrepès i obesitat juvenil a nivell regional i local. A la taula 9 es recullen dades de prevalença de sobrepès i obesitat juvenil dels estudis regionals i locals més representatius realitzats a la vegada o després de l'estudi enKid.

Taula 7. Prevalença de sobrepès i obesitat entre els nins i adolescents espanyols de 2 a 17 anys per comunitat autònoma, ENS 2006.

	Sobrepès (%)			Obesitat (%)		
	Total	**Al·lots**	**Al·lotes**	**Total**	**Al·lots**	**Al·lotes**
Total	72.4	20.2	17.1	8.9	9.1	8.7
Andalusia	68.3	19.3	20.1	12.0	11.8	12.1
Aragó	75.6	15.8	18.1	7.5	10.3	4.3
Astúries (Principat de)	71.6	23.3	24.3	4.6	3.8	5.2
Balears (Illes)	73.0	19.9	18.2	7.8	8.7	6.5
Canàries	61.0	26.4	19.5	15.9	12.9	19.2
Cantàbria	71.8	23.9	17.9	7.0	7.0	7.0
Castella i Lleó	76.8	15.3	15.8	7.6	9.2	6.0
Castella la Manxa	68.5	28.3	22.7	5.5	7.0	3.4
Catalunya	76.8	20.3	11.5	7.2	8.1	6.2
Comunitat Valenciana	72.0	16.4	14.8	12.4	11.8	13.1
Extremadura	70.4	22.0	16.8	9.8	12.7	6.1
Galícia	75.0	23.7	15.3	5.2	4.8	5.6
Madrid (Comunitat de)	75.0	21.9	17.2	5.5	5.1	5.8
Múrcia (Regió de)	67.3	22.5	21.3	10.8	15.0	6.9
Navarra (Comunitat foral de)	72.4	18.4	20.4	8.2	5.2	11.5
País Basc	80.5	12.7	15.9	5.1	5.7	4.6
Rioja (La)	68.9	22.3	15.2	12.4	8.3	16.5
Ceuta i Melilla	70.4	5.7	27.5	14.2	16.9	10.8

Font: Ministeri de Sanitat, Política Social i Igualtat. Enquesta Nacional de Salut (ENS). Madrid: Ministeri de Sanitat, Política Social i Igualtat, 2006. Distribució percentual segons els criteris IOTF. Població de 2 a 17 anys.

Taula 8. Prevalença de sobrepès i obesitat entre els adolescents espanyols de 10 a 17 anys, ENS 2003 i ENS 2006.

		Sobrepès (%)		Obesitat (%)	
	Edat (anys)	**2003**	**2006**	**2003**	**2006**
Total	10 a 14	18.7	20.0	3.0	5.1
	15 a 17	10.6	17.0	1.8	2.2
Al·lots	10 a 14	20.8	23.6	3.1	6.1
	15 a 17	12.9	21.3	2.7	1.8
Al·lotes	10 a 14	16.5	15.9	2.8	3.9
	15 a 17	7.9	13.1	0.7	2.6

Font: Ministeri de Sanitat, Política Social i Igualtat. Enquesta Nacional de Salut (ENS). Madrid: Ministeri de Sanitat, Política Social i Igualtat, 2003. Ministeri de Sanitat, Política Social i Igualtat. Enquesta Nacional de Salut (ENS). Madrid: Ministeri de Sanitat, Política Social i Igualtat, 2006. Distribució percentual segons els criteris IOTF. Població de 2 a 17 anys.

Taula 9. Prevalença (%) de sobrepès i obesitat en diverses regions i localitats espanyoles

Lloc d'estudi	Any	Població estudiada	Edat (anys)	*n*	Criteri	Prevalença	Ref.
Madrid, Fuenlabrada	2003	Estudi transversal en AP en població de 2 a 14 anys	11	40	IOTF	SB: 20.6%M, 20.7%F OB: 25.1%M, 25.4%F	[153]
					CDC[1]	SB: 20.2%M, 20.8%F OB: 23.2%M, 24.0%F	
					Hernández et al.[2]	OB: 21.8%M, 22.9%F	
			14	52	IOTF	SB: 22.6%M, 23.3%F OB: 27.6%M, 28.6%F	
					CDC[1]	SB: 22.6%M, 23.3%F OB: 26.0%M, 27.2%F	
					Hernández et al.[2]	OB: 24.5%M, 25.7%F	
Madrid, Fuenlabrada	1989-2007	Estudi longitudinal en AP en nins nascuts al 1989	18	153	SB: IMC≥25 kg/m^2 OB: IMC≥30 kg/m^2	SB: 18.3%T, 26.6%M, 12.4%F OB: 7.2%T, 6.3%M, 7.9%F	[154]
Sevilla, Carmona	2003	Estudi transversal en població escolar de 9 a 17 anys	9-17	1,534	IOTF	OB: 7.4%T, 8.8%M, 6.0%F	[155]
Galícia	1991-2001	Tres estudis transversals de població escolar (estudi GALINUT)	10-12	1991, *n*=1,906 2001, *n*=2,286	CDC[1]	OB: 1991: 5.5%T, 2001: 14.4%T	[156]
					Hernández et al.[2]	OB: 1991: 8.8%T, 2001: 20.5%T	
					Estudi enKid[1]	OB: 1991: 11.8%T, 2001: 15.9%T	
Madrid	1999-2002	Estudi transversal en població escolar de 6 a 20 anys	13-20	5,572	IOTF	SB: 18.8%M, 14.6%F OB: 4.7%M, 2.8%F	[157]
					Hernández et al.[3]	SB: 10.6%M, 9.5%F OB: 10.3%M, 12.2%F	
Granada, Madrid, Santander, Saragossa, Múrcia (multicèntric)	2000-2002	Estudi transversal en població escolar adolescent (estudi AVENA)	13-18.5	2,320	IOTF	SB: 20.0%M, 16.1%F OB: 5.7%M, 3.1%F	[158]
Astúries, Oviedo	1992-2004/06	Dos estudis transversals en població escolar de 6 a 17 anys	12-17	-	IOTF	SB: 1992: 20.9%T 2004/06: 20.3%T OB: 1992: 3.8%T, 6.6%M, 0.9%F 2004/06: 4.8%T, 5.8%M, 3.8%F	[159]
País Basc	2004-2005	Estudi transversal en la població de 4 a 18 anys	12-18	690	IOTF	SB: 21.6%T OB: 4.3%T	[160]
Canàries	2004-2005	Estudi transversal en població escolar de 12 a 14 anys	12-14	1,002	IOTF	SB: 21.6%T, 21.0%M, 22.2%F OB: 7.5%T, 7.8%M, 7.2%F	[161]

Abreviatures: AP, Atenció Primària; SB, sobrepès; OB, obesitat; IOTF, *International Obesity Task Force*; CDC, *Centers for Disease Control and Prevention growth charts*, T, total; M, masculí (sexe); F, femení (sexe); Ref., referència.

Criteris de definició del sobrepès i l'obesitat: [1]Sobrepès definit com a IMC≥P85 i <P95, i obesitat com a IMC≥P95 per edat i sexe. [2]Obesitat definida com a IMC≥P97 per edat i sexe. [3]Sobrepès definit com a IMC≥P90 i <P97, i obesitat com a IMC≥P97 per edat i sexe. [4]Només analitzats de 10 a 12 anys el 2001.

2.2. Causes i conseqüències del sobrepès i l'obesitat infanto-juvenil

2.2.1. Factors que predisposen al sobrepès i l'obesitat

L'etiopatogènia del sobrepès i l'obesitat és multifactorial, és a dir, intervenen patrons de creixement i desenvolupament, factors genètics, neuroendocrins, psicològics, ambientals i socioculturals [76]. Però només en un petit nombre de casos l'obesitat infanto-juvenil està relacionada exclusivament amb els gens, factors neuroendocrins (deficiència de l'hormona de creixement, hipotiroïdisme, excés de cortisol i lesions a nivell del sistema nerviós central) o efectes secundaris d'alguns medicaments [10,77]. És a dir, en la majoria de casos l'obesitat està relacionada amb una interacció entre factors genètics i ambientals [78]. I és que els gens influeixen en la susceptibilitat d'un nin a l'obesitat, tot i que han estat els factors ambientals els que han intervingut significativament en la creixent prevalença de sobrepès i obesitat en les darreres dècades [10]. En general, es confirma que l'obesitat es produeix quan la ingesta energètica sobrepassa la despesa energètica [10].

2.2.1.1. Patrons de creixement i desenvolupament

Hi ha tres períodes crítics en l'evolució de l'obesitat: el període fetal, el període de rebot adipós i l'adolescència [79].

Període fetal. Els patrons de creixement intrauterins duen a terme un paper important en l'evolució de l'obesitat mitjançant la modificació de la MG i la MLG, mecanismes neuroendocrins de control de la fam i la capacitat funcional del pàncrees [76]. L'estat de salut, el pes i la nutrició de la dona embarassada repercuteix en el creixement i el desenvolupament fetal [80]. Així, els nins de mares obeses i diabètiques tenen més risc de tenir sobrepès en néixer i obesitat en edats posteriors de la seva vida [78,80]. Però un baix pes en néixer també afavoreix el desenvolupament de l'obesitat, la diabetis mellitus de tipus 2, hipertensió, hiperlipidèmia, SMet, malaltia coronària i arteriosclerosis en la vida adulta [76,78].

Període de rebot adipós. Entre els 5-6 anys té lloc un rebot adipós, és a dir, comença a incrementar-se el nombre d'adipòcits a l'organisme [80]. L'edat del rebot adipós i el risc d'obesitat estan inversament relacionats. Així, un rebot a edat primerenca (≤5 anys) augmenta significativament el risc posterior d'obesitat en relació amb aquells que el presenten més tard (>6 anys) [78], tant en nins i adolescents com a l'edat adulta [80]. Per tant, que el rebot adipós tingui lloc a edats primerenques podria ser un factor més en l'increment de la prevalença de l'obesitat [78,80].

L'adolescència. En l'adolescència tenen lloc importants canvis fisiològics i psicosocials que influeixen en la imatge corporal (IC), els hàbits de vida i especialment, en els patrons alimentaris, d'activitat física (AF) i d'oci [80]. Aquestes circumstàncies afavoreixen el desenvolupament de sobrepès i obesitat amb un alt risc de persistir a l'etapa adulta [80]. Però també s'ha observat que la pubertat és una època clau per al desenvolupament de l'obesitat, en especial en el sexe femení [78]. I és que existeixen evidències que estableixen una correlació negativa entre l'edat de la menarquia (primera menstruació) i el nivell d'adipositat i IMC, així com el risc d'obesitat posterior [76,78,80]. Així, les nines amb menarquia primerenca (<11 anys) tenen una probabilitat dues vegades major de convertir-se en adultes obeses que les que presenten la maduració més tard (>14 anys) [78]. En canvi, als nins la situació és inversa, ja que quant abans inicien el desenvolupament sexual, menor és el risc de sobrepès i obesitat [80,81]. També s'ha indicat que mentre que el 70% dels adolescents obesos normalitzen el pes corporal a l'edat adulta, només ho fan un 20% de les adolescents obeses. Aleshores, l'obesitat a les al·lotes adolescents sol ser més persistent en l'edat adulta [78].

2.2.1.2. Factors genètics

L'evidència més convincent d'un component genètic a l'obesitat s'ha establert amb estudis de bessons i d'adopció [82-84]. Aquests estudis han posat de manifest que aproximadament el 40-80% del fenotip d'obesitat s'hereta [83,85]. També s'ha indicat que el risc d'obesitat d'un nin és 4 vegades major si un dels pares és obès i 8 vegades major si els dos pares són obesos [82]. Però tot i que l'herència de l'IMC és alta, encara es desconeix el mecanisme exacte de com la genètica influeix sobre l'IMC.

L'etiologia exclusivament genètica (monogènica) s'ha relacionat amb mutacions en gens que intervenen en els mecanismes endògens del control del pes (ex: la leptina i el seu receptor, la proopiomelanocortina i el receptor de la melanocortina-4, etc.) [84,86], afectant principalment a la regulació de la sacietat [87]. Però només el 5-10% dels casos d'obesitat poden ser explicats per una causa monogènica [84,86,87]. Aleshores, la majoria de casos d'obesitat estan associats a una herència poligènica predisposada a l'acumulació de GC que dependria de factors ambientals. És a dir, la pandèmia actual de l'obesitat s'ha d'interpretar com el resultat de l'evolució al desenvolupament d'un sistema metabòlic eficient per a l'acumulació, emmagatzemament i defensa d'energia que permet sobreviure en èpoques d'escassa disponibilitat d'aliments [88] però que estaria en contra de les societats desenvolupades [78] en les quals s'ha creat un "ambient obsogènic" [88]. I és que a les societats desenvolupades s'ha maximitzat la ingesta d'energia i minimitzat l'esforç físic i la despesa energètica [88].

Actualment encara no s'han caracteritzat tots els gens que podrien estar associats amb l'obesitat, però el 2006 es van identificar més de 600 *loci* que afecten al control del pes [89].

2.2.1.3. Factors ambientals

En general, els dos components principals de l'obesitat infantil són la inactivitat física i l'alimentació inadequada. Però de cada vegada és més evident que l'entorn social i físic pot determinar el nivell d'exposició a aquests factors de risc [90].

Factors familiars

El paper que l'entorn familiar representa en el desenvolupament de l'obesitat està àmpliament reconegut com a factor crític [78]. Tenir un o els dos pares amb obesitat és un determinant per a l'obesitat infantil, i fins i tot un predictor més potent d'obesitat en l'etapa adulta que el propi pes del nin abans dels 3 anys [76]. A més, a les famílies on només un dels pares el que presenta obesitat, s'ha observat que la probabilitat que el nin sigui obès és major quan és la mare i no el pare és el progenitor obès [76]. Per tant, l'obesitat infanto-juvenil està relacionada per una herència genètica, però també per factors ambientals que inclouen l'entorn familiar. Així per exemple, un baix nivell socioeconòmic i un baix nivell educatiu, especialment de la mare, està relacionat amb el risc d'obesitat en el seus fills, tant en la infància i adolescència com a l'etapa adulta [80]. Per altra banda, a part del baix nivell educatiu i socioeconòmic, si la mare a més és obesa, el risc d'obesitat del seu fill incrementa significativament [80]. Per una banda, perquè freqüentment aquestes mares no identifiquen els seus fills com a obesos [80], i per l'altra, perquè no es pot descartar el paper fonamental que usualment han tingut les mares en l'alimentació en la cultura occidental, ja que en la majoria de famílies són elles les responsables de la compra i preparació dels aliments [91]. Un altre aspecte important és que s'ha observat que menjar en família ajuda a millorar la qualitat de la dieta, amb un major consum de fruites, vegetals i fibra, i menys aliments rics en grasses saturades i trans [80].

Per altra banda, no es pot obviar que el risc d'obesitat també està associat amb el tabaquisme i la diabetis durant l'embaràs [78], mentre que la lactància materna sembla tenir un paper protector petit però constant contra l'obesitat [76].

Factors comportamentals

Alimentació. El consum d'energia és difícil de mesurar amb precisió [10] a causa d'una sèrie de limitacions relacionades principalment amb la inexactitud de la metodologia en la recollida de les dades per a avaluar la ingesta (recordatori de 24 hores, registre de 3 dies, freqüència de consum d'aliments, etc.), així com a la tendència que tenen les persones obeses a infravalorar la seva ingesta [78]. Malgrat això, és evident que l'increment de l'adipositat experimentat en les darreres dècades es relaciona amb profunds canvis en els patrons d'alimentació [76,80], els quals estan relacionats amb factors com els nous tipus familiars, la incorporació massiva i legítima de la dona a la feina fora de casa, el progrés econòmic i la creixent urbanització [80]. Aquests canvis engloben un increment del consum de menjar ràpid (fast food i snacks) i begudes blanes (no alcohòliques, que contenen sucres, coles, sucs); un augment de les dimensions de les racions dels aliments manufacturats (hamburgueses, pizza, patata fregida, pasta, crispetes, galetes, brioixeria, salats, postres i begudes blanes) que es consumeixen tant als establiments de menjar ràpid, als restaurants o a casa mateix; un major consum d'aliments en restaurants i llocs de menjar ràpid; i un menor consum de fruites i verdures [80]. I és que aquests comportaments són cultivats en un entorn en el que els aliments d'alt contingut energètic són molt abundants, assequibles, accessibles i fàcils de consumir [76]. Així, per exemple, els nins i adolescents poden trobar aquests aliments a les màquines de venda situades a les pròpies escoles, les quals reben incentius financers per permetre la seva presència [83].

Alguns estudis també han demostrat una associació positiva entre l'esmorzar i el sobrepès en nins [80], així com amb la qualitat nutricional de la dieta [80]. El número de menjades diàries també s'ha relacionat amb la prevalença d'obesitat en nombrosos estudis [92-101]. Per altra banda, la TV no només augmenta el temps d'inactivitat, sinó que també produeix efectes en la composició i la qualitat de la dieta, en els patrons d'alimentació [80]. I és que els nins i adolescents són un mercat prioritari per la indústria de l'alimentació que aplica sofisticades tècniques de mercat i psicologia social per a la promoció i venta dels seus productes [80].

Activitat física. S'ha demostrat que una vida sedentària s'associa amb un major risc d'obesitat, encara que la quantitat d'AF necessària per a aconseguir un efecte saludable i disminuir el risc d'obesitat no està ben determinada [102]. Però és evident que a les creixents taxes d'obesitat ha contribuït la disminució de l'AF en tots els grups d'edat [10].

A la majoria de les famílies, com que els dos pares treballen, els nins estan menys temps a l'aire lliure i en canvi, passen més temps mirant la TV i jugant amb l'ordinador i les consoles [83]. Les hores invertides a la TV i a altres activitats sedentàries s'han relacionat amb l'obesitat [10,76]. Així, per exemple, la taxa d'obesitat infantil és 8.4 vegades major en el cas dels nins que miren la TV 5 hores al dia en comparació amb els nins que la veuen 2 o menys hores diàries [83]. Però s'ha postulat que són especialment els adolescents els que mostren una baixa participació en esports i educació física [10]. De fet, a l'estudi enKid, realitzat amb 3185 nins espanyols de 2 a 24 anys [35], es va observar que la pràctica habitual d'exercici disminuïa a partir del grup d'adolescents de 11-13 anys, i en canvi, augmentava el temps de veure la TV i el temps invertit a l'ordinador i les consoles, essent màxim als 14-17 anys.

Cal tenir en compte que els baixos nivells d'AF de la societat actual també són impulsats, sens dubte, per un entorn de transport automatitzat (ascensors i escales mecàniques) i automobilitzat que condueix a un estil de vida sedentari [76,83].

Finalment, tot i que hi ha controvèrsies en els resultats obtinguts, alguns estudis demostren que dormir poques hores també estaria associat amb una major probabilitat d'ésser obès, així com un augment del percentatge del GC [76].

Altres factors comportamentals i socials. La preocupació per una aparença externa més acceptable socialment pot conduir a comportaments que posen en risc la salut de l'individu. L'adolescència en particular, és l'etapa amb major prevalença de trastorns de la conducta alimentària, com anorèxia, bulímia i el recent trastorn alimentari anomenat *trastorn per afartament*. Aquestes malalties tan poden ser un factor etiopatogènic com conseqüència de l'obesitat [103]. Però per altra banda, també s'ha definit una «contagiositat social» de l'obesitat, que no respondria a una conducta imitativa [104] però sí a una acceptació de l'obesitat, la qual s'ha observat tant en adolescents [105] com en adults [104]. Aquesta acceptació de l'obesitat pot convertir-se en un factor determinant important.

Context físic

Hi ha evidències que indiquen que el comportament alimentari i d'AF estan influenciats pel disseny de les comunitats [76,90] i les característiques de les infraestructures [76]. Així, per exemple, s'ha observat un major risc d'obesitat en adolescents que tenen restaurants de menjar ràpid a prop de les escoles [90]. Per altra banda, la disponibilitat de carrils de bicicleta, zones de joc i altres llocs de recreació relacionats amb l'AF també són factors importants en la determinació dels nivells d'obesitat en les poblacions [76].

2.2.2. Conseqüències de l'obesitat

L'obesitat infantil és un problema de salut pública per dues raons, perquè està associada a una gran varietat de problemes de salut; i perquè l'obès no és percebut com atractiu en el món occidental, fet que en molts individus segurament és causa d'infelicitat [23]. L'augment de la incidència de l'obesitat ha anat acompanyada de l'aparició i identificació de nous condicionants de salut associats a l'obesitat [70,83]. En general, es pot dir que l'obesitat infanto-juvenil pot tenir conseqüències a tres nivells: (1) a curt termini, és a dir, a l'infant o a l'adolescent; (2) a llarg termini, és a dir, a l'etapa adulta; i (3) econòmiques. Algunes de les conseqüències relacionades amb l'obesitat infanto-juvenil es presenten a la Taula 10.

2.2.2.1. Conseqüències a curt termini

Conseqüències psicològiques i socials

Encara que per a una perspectiva de salut pública és més important l'impacte que té l'obesitat infantil i adolescent sobre la salut física, probablement l'aspecte psicosocial sigui l'efecte advers més estès en el món desenvolupat [22]. I és que la repercussió que l'obesitat té sobre el desenvolupament psicològic i l'adaptació social del nin i l'adolescent és molt important [82]. En general, les persones obeses no estan ben considerades en la societat, i fins i tot en els mitjans de comunicació els nins i adults obesos solen representar un personatge còmic i golafre [82]. De fet, els nins i adolescents obesos són més propensos a experimentar problemes psicològics que els nins no obesos [21]. I és que, els nins i adolescents obesos poden ser objecte d'estigmatització basada en el seu pes, de burles i d'intimidació; i no només per part dels seus companys, sinó també pels seus professors i pares [106]. L'obesitat en si, així com el grau de les burles, poden estar associades amb una major preocupació pel pes [76], insatisfacció corporal, baixa autoestima, depressió [21,76,107] i problemes conductuals [21]. A més, el grau de les burles que pateix el nin o l'adolescent s'associa també amb més soledat, major preferència per les activitats sedentàries o aïllament, i menor preferència per les activitats socials [76]. Freqüentment, el rebuig per part dels adults o dels companys també produeix com a resposta un augment de la ingesta d'aliments, fet que agreuja o almenys perpetua l'obesitat [82]. Fins i tot, entre aquells adolescents que compleixen el criteri per al *trastorn per afartament* principalment s'ha arribat a associar menjar en excés amb tendències suïcides [76].

En l'adolescència, el concepte d'un mateix té tanta importància que qualsevol característica física que el diferenciï de la resta dels seus companys té el potencial de convertir-se en un problema més greu [82]. I encara que ambdós sexes es poden veure afectats psicològicament per l'obesitat, són les al·lotes les que tenen un major risc de desenvolupar trastorns de depressió o ansietat [76]. Per altra banda, també cal tenir en compte que el risc de patir experiències psicològiques negatives associades amb l'obesitat augmenta amb l'edat [21].

Però cal dir que no totes les cultures consideren l'excés de pes com a un atribut negatiu [70]. Així, per exemple, un estudi realitzat a Mèxic assenyalà que els nins obesos mexicans no tenen més problemes socials (rebuig o estigma per part dels seus companys) ni problemes psicològics (ansietat, depressió o baixa estima) que els companys no obesos [70]. I és possible que hi hagi patrons culturals similars a altres regions del món, i dins de subpoblacions de les societats industrialitzades occidentals [70].

Factors de risc cardiovascular en la infància i l'adolescència

Des de fa temps, l'obesitat infantil i adolescent ha estat considerada un factor determinant d'una sèrie de factors de risc cardiovascular a l'edat adulta [76]. Però així com abans es pensava que els nins obesos no patien problemes cardiovasculars fins a l'etapa adulta, actualment es reconeix que no només poden tenir complicacions cardiovasculars a llarg, sinó també, a curt termini [21,108]. Els nins i els adolescents obesos tenen un major risc de complicacions cardiovasculars, que inclouen: pressió arterial alta [21,76,108]; canvis en l'estructura i funció vascular; canvis en l'estructura i funció del ventricle esquerra [76,108]; dislipidèmia, resistència a la insulina/hiperinsulinèmia i intolerància a la glucosa/diabetis de tipus 2 [21,76].

Síndrome metabòlica. La combinació de les complicacions metabòliques que apareixen en els individus obesos i incrementen el risc cardiovascular es coneix com a SMet [61] o síndrome X. Però la definició del SMet difereix entre les diferents organitzacions [77]. El tercer informe del *National Cholesterol Education Program Adult Treatment Panel* (NCEP-ATPIII) va identificar 6 components del SMet com a un factor de risc múltiple per a la malaltia cardiovascular: obesitat abdominal, dislipidèmia aterogènica, pressió arterial elevada, resistència a la insulina i/o intolerància a la glucosa, estat proinflamatori i estat protrombòtic [109]. L'obesitat abdominal és la forma d'obesitat més fortament associada al SMet [110]; la dislipidèmia aterogènica es manifesta principalment amb una elevada concentració sèrica de colesterol, colesterol associat a les lipoproteïnes de baixa densitat (colesterol LDL o «colesterol dolent»), colesterol associat a lipoproteïnes de molt baixa densitat (colesterol VLDL), triglicèrids (TGs) i apolipoproteïna B, així com una reducció del colesterol associat a proteïnes d'alta densitat (colesterol HDL o «colesterol bo») [111]; la pressió arterial alta està fortament associada amb l'obesitat i es diagnostica freqüentment en persones amb resistència a la insulina; la resistència a la insulina és un factor de risc que es manifesta freqüentment amb intolerància a la glucosa, un important factor de risc independent de malaltia cardiovascular; un estat proinflamatori és reconegut clínicament per l'elevació de la proteïna C reactiva (PCR), ja que l'excés de teixit adipós allibera citoquines inflamatòries que poden provocar majors nivells de PCR; i un estat protrombòtic es caracteritza per l'augment en plasma de l'inhibidor de l'activador del plasminogen-1 (PAI-1) i el fibrinogen [110]. Però els criteris de l'ATPIII per al diagnòstic del SMet és complir tres de les cinc característiques següents: obesitat abdominal, elevats nivells de TGs, baixos nivells de colesterol HDL, pressió arterial elevada i elevada glucèmia plasmàtica [110].

La prevalença de SMet entre els adolescents s'ha estimat que és del 4%, i mentre que aquesta prevalença seria baixa entre els nins i adolescents amb normopès, és alta entre els obesos (30-50%) [22,112-114]. Igual que als adults obesos, sembla que a nins i adolescents l'obesitat estaria fortament associada amb la hipertensió [70]. Per altra banda, els nivells baixos de colesterol HDL, i els nivells alts de colesterol LDL i TGs estan fortament correlacionats en els adolescents amb plecs cutanis i un IMC majors (principalment per damunt del percentil 97) [70].

Diabetis mellitus de tipus 2

L'obesitat està altament associada amb la diabetis de tipus 2. Mentre que tradicionalment, la diabetis de tipus 2 ha estat una malaltia més comuna en l'adult, actualment s'està diagnosticant freqüentment tant en nins com en adolescents [70,76]. Tot i haver-hi altres factors associats amb la diabetis de tipus 2 en nins i adolescents (antecedents familiars, ètnia i la presència d'acantosis nigricans), el factor de risc més important per al seu desenvolupament és l'obesitat [70].

Alteracions del desenvolupament puberal

Els nins i els adolescents obesos poden presentar alteracions del desenvolupament puberal [82]. En les nines, l'obesitat s'ha associat amb una maduració sexual avançada (menarquia primerenca), trastorns menstruals i el síndrome d'ovari poliquístic [70]. En canvi, els nins amb sobrepès tendeixen a mostrar una maduració sexual més tardana que els seus coetanis sense sobrepès [70].

Taula 10. Conseqüències de l'obesitat infanto-juvenil

Psicològiques i socials
Baixa autoestima
Depressió
Insatisfacció corporal
Problemes conductuals
Cardiovasculars
Aterosclerosi
Dislipidèmia
Hipertensió
Hipertròfia ventricle esquerre
Endocrines
Alteracions desenvolupament puberal
Diabetis mellitus tipus 2
Resistència a la insulina
Síndrome d'ovari poliquístic
Dermatològiques
Acantosis nigricans
Estries
Infeccions per fongs
Pulmonars
Apnea obstructiva del son
Asma
Broncoespasme
Disminució capacitat pulmonar
Dispnea d'esforç
Ortopèdiques
Artrosis
Deformitats òssies
Lesions articulars
Gastrointestinals
Colelitiasis
Malaltia no-alcohòlica del fetge gras
Reflux gastroesofàgic
Neurològiques
Hipertensió intracraneal idiopàtica
Altres
Inflamació sistèmica

Menarquia primerenca. Existeixen evidències que estableixen una correlació negativa entre l'edat de la menarquia i el nivell d'adipositat, l'IMC i el risc d'obesitat posterior [76,78,80]. Però a més, el moment de la menarquia està influenciada pel pes, amb un risc incrementat en les nines amb sobrepès i obesitat [70]. La pubertat avançada està relacionada amb una maduració sexual i un creixement precoç, el qual pot traduir-se en una disminució de la talla final [82].

Trastorns menstruals i síndrome d'ovari poliquístic. En les al·lotes adolescents i les dones joves, l'excés de greix abdominal s'associa amb hiperandrogenèmia [77]. A més, a part de l'elevada correlació entre el greix abdominal i la resistència a la insulina en els adolescents obesos, també existeix una relació causal entre l'alta activitat dels andrògens i la hiperinsulinèmia en les adolescents [77]. La resistència a la insulina estimula l'ovari, així com la producció d'andrògens suprarenals i d'estrògens [77].

A més, les al·lotes obeses tenen més baixes concentracions de globulina transportadora d'hormones sexuals, fet que augmenta la fracció de les hormones sexuals biològicament activa (en estat lliure) [77]. Aquestes pertorbacions hormonals incrementen el risc de les al·lotes adolescents de patir trastorns menstruals i l'aparició primerenca del síndrome d'ovari poliquístic [77]. El síndrome de l'ovari poliquístic és el trastorn endocrí més comú en les dones adultes [81] però actualment també ho és en nines puberals joves [115]. Els símptomes comuns del síndrome d'ovari poliquístic inclouen anormalitats menstruals (oligomenorrea o amenorrea), resistència a la insulina, hirsutisme (augment excessiu del pèl corporal), acné, acantosis nigricans, pèrdua de pèl o adrenarquia prematura [81] i hiperandrogenisme [111,116].

Retard en la maduració sexual en els nins. Els nins amb sobrepès i obesitat presenten una maduració sexual més tardana [70]. A més, mentre que en els companys més prims la pubertat està associada a una disminució de la MG i un augment de la MLG; en els nins més pesats ocorre un increment tant de la MLG com de la MG [81]. També és freqüent en els nins prepúbers el pseudohipogenitalisme, ja que el greix suprapúbic oculta la base del penis disminuint la seva mida real, i la ginecomàstia, és a dir, l'acumulació de greix a la regió mamària [82].

Trastorns respiratoris i asma

L'obesitat també s'ha associat amb problemes respiratoris com dispnea d'esforç, broncospasme, asma, disminució de la capacitat pulmonar i apnea obstructiva del son [82]. Aquest darrer problema respiratori, l'apnea obstructiva del son, està associat amb una major resistència al flux d'aire a través de les vies respiratòries superiors, roncar fort, la reducció en el flux d'aire (hipopnea) i aturada de la respiració (apnea) [70]. Per tant, podria iniciar o aportar algunes de les conseqüències cardiovasculars de l'obesitat [108]. A més, s'ha relacionat amb efectes significatius en l'aprenentatge i la memòria en aquells nins amb obesitat severa [70].

Conseqüències a l'aparell digestiu

Fetge gras. La malaltia del fetge gras per causa no alcohòlica és un problema de cada vegada més freqüent en els nins obesos [70,77]. La història de la malaltia varia en funció de la histologia: l'esteatosi hepàtica es caracteritza freqüentment per un curs clínic benigne sense progressió histològica, mentre que l'esteatohepatitis no alcohòlica pot estar associada a un augment de fibrosis i a cirrosis [70,77]. En la infància sol ser una malaltia silenciosa i és detectada per l'elevació asimptomàtica de les transaminases hepàtiques [70]. Però alguns nins poden tenir malestar general o abdominal, debilitat, fatiga, sensació de plenitud, molèstia en el quadrant superior dret o acantosis nigricans [70,77].

Colelitiasis. L'obesitat és un dels factors de risc important per al desenvolupament de càlculs biliars, i el seu diagnòstic s'ha de considerar en cas de dolor abdominal persistent en adolescents obesos [77].

Conseqüències ortopèdiques

Els nins amb sobrepès i obesitat són susceptibles a desenvolupar deformitats òssies, lesions articulars i artrosis [77,82].

Conseqüències demartològiques

L'acumulació de greix freqüentment provoca trastorns dermatològics, com la presència d'estries i infeccions per fongs en les zones de plecs cutanis [82]. L'acantosis nigricans també és freqüent en els joves obesos i es caracteritza per plaques d'hiperpigmentació i hiperqueratosi en la superfície dorsal del coll, les axil·les, els plecs del cos i sobre les articulacions [77].

Conseqüències neurològiques

L'obesitat està associada amb la hipertensió intracraneal idiopàtica o pseudotumor cerebral, i es manifesta per mal de cap, alteracions de la visió, tinnitus (cops o xiuletades en l'oïda) i paràlisi del sisè nervi [77].

2.2.2.2. Conseqüències a llarg termini

L'obesitat infanto-juvenil s'ha associat significativament amb un major risc de mortalitat prematura i morbiditat dels adults, especialment la morbiditat cardiometabòlica [116]. A continuació s'exposen les conseqüències de l'obesitat infanto-juvenil a l'edat adulta.

Persistència de l'obesitat des de la infància o l'adolescència

L'obesitat infanto-juvenil tendeix a persistir a l'edat adulta [3,21,22], i aquesta tendència a créixer obès es troba augmentada amb la severitat de l'obesitat [22]. A més, el fet que almenys un dels dos pares sigui obès també influeix en el risc de persistència d'obesitat infanto-juvenil a l'edat adulta [22]. Així, avui en dia es postula que almenys el 60% dels nins obesos i el 70-80% dels adolescents obesos es converteixen en adults obesos [22]. Cal fer notar però que la persistència d'obesitat en l'edat adulta és major si es tracta d'un adolescent [22].

Factors de risc cardiovascular

Hi ha diversos estudis que han demostrat una relació entre l'augment de pes en la infància i l'adolescència, i el posterior increment dels factors de risc cardiovascular en l'edat adulta [3,21,70,116]. El *Bogalusa Heart Study* és un dels estudis que ha proporcionat informació detallada sobre el risc cardiovascular en l'adolescència (13-17 anys) i la seva persistència en els adults joves (27-31 anys) [70,117]. Com a adults joves, el grup amb sobrepès (IMC superior al percentil 75) va mostrar nivells adversos de GC, pressió arterial sistòlica i diastòlica, colesterol, insulina i glucosa, en comparació del grup amb normopès (IMC entre els percentils 25 i 50) [117]. En l'estudi, el sobrepès a l'adolescència es va associar a un augment de 8.5 vegades la hipertensió arterial, 8.3 vegades elevats nivells de TGs, 2.5 vegades elevats nivells de colesterol total, 3.1 vegades elevats nivells de colesterol LDL i 5.4 vegades baixos nivells de colesterol HDL [117]. L'associació entre els nivells de lipoproteïnes a la infància i l'edat adulta també s'observà en un estudi longitudinal de més de 15 anys de seguiment de nins i adolescents de 5 a 14 anys a l'inici de l'estudi. Però en aquest estudi l'associació va ser major per al colesterol total (r=0.6) i el colesterol LDL (r=0.4-0.6), que per al colesterol HDL (r=0.4) i els TGs (r=0.1-0.4) [70].

Hipertensió. L'obesitat en nins i adults està associada amb la hipertensió. El *Task Force on Blood Pressure* va indicar que la detecció i prevenció, així com el tractament precoç de la hipertensió en la població pediàtrica, contribueix a una reducció de l'alt risc de morbiditat a l'edat adulta [70].

Lípids plasmàtics i lipoproteïnes. S'ha demostrat un associació entre l'augment de pes i l'increment dels nivells lipídics plasmàtics i de les lipoproteïnes durant la transició entre l'adolescència i l'edat adulta [70].

Aterosclerosi. Tot i que els estadis inicials de l'aterosclerosi estan associats amb la hipercolesterolèmia materna en els nounats; l'obesitat infantil i adolescent també és important en el desenvolupament d'aquestes lesions [118]. La relació entre l'obesitat infantil i juvenil amb l'aterosclerosi ha estat analitzada amb la quantificació de la gruixa de l'íntima-mitja carotídia arterial (IMT), que a més és marcador de risc de factors de cardiopatia coronària [118]. En el *Muscatine Heart Study* es va indicar que els nivells d'IMC i els plecs cutanis dels nins i adolescents de 8 a 18 anys permetien predir la gruixa de l'IMT en l'adult (33 a 42 anys) [118].

Cardiopatia coronària. Hi ha estudis que suggereixen que els nins amb sobrepès tenen un major risc de cardiopatia coronària a l'edat adulta, amb riscs relatius entre 1.7 i 2.6 [118]. A més, cal fer notar que amb el ritme que incrementa l'obesitat entre els adolescents, als EEUU s'ha calculat que l'any 2035 la prevalença de cardiopatia coronària incrementarà en un rang del 5% al 16% [119]. I és que més dels 100,000 casos de més de cardiopatia coronària podran atribuir-se a l'augment de l'obesitat. [119].

Diabetis mellitus de tipus 2

L'obesitat i la diabetis de tipus mellitus de tipus 2 estan fortament associades, en ambdós sexes i en tots els grups ètnics [111,120]. Però a més, l'aparició de diabetis en la joventut augmenta el risc de complicacions avançades de la malaltia en l'etapa adulta (la malaltia cardiovascular, insuficiència renal, alteracions visuals i amputacions de les extremitats) [70]. Cal fer notar que hi ha un «cicle diabètic», i és que la diabetis materna incrementa el risc de sobrepès en el nin. A més, el sobrepès en els nins i adolescents augmenta el risc de diabetis i, per tant, en el cas que les al·lotes desenvolupin diabetis és probable que tinguin fills amb un major pes i amb risc de desenvolupar obesitat infantil i juvenil [70].

Càncer

L'Agència Internacional de l'OMS per a la Investigació del Càncer ha estimat que el sobrepès i la inactivitat incrementen en un 25-30% el risc de càncer d'esòfag, còlon i recte, mama i ronyó [111]. La menarquia precoç en les nines és un factor de risc per al càncer de mama i s'ha relacionat amb altres tipus de càncer del sistema reproductiu femení [70].

Conseqüències psicològiques i socials

L'obesitat en l'adolescència té efectes adversos sobre els resultats socials i econòmics a l'etapa adulta, els quals podrien ser més marcats en les dones que els homes [21,111]. I és que en els països desenvolupats hi ha un estigma associat amb l'obesitat en àrees com l'educació, el treball i la salut [111]. Així, per exemple, estudis realitzats en els EEUU i el Regne Unit han indicat que les al·lotes obeses en l'adolescència es convertiren en adults que, en comparació amb les al·lotes primes, tenien menor nivell educatiu, guanyaven menys diners, experimentaven taxes de pobresa més elevades i tenien una menor probabilitat de matrimoni [70]. Per altra banda, el rebuig per part dels companys i la falta d'amistat durant la infància, si es dóna el cas, s'ha associat amb una reducció del funcionament psicològic a l'edat adulta [70]. A més, també s'ha de tenir en compte la insatisfacció corporal, la baixa autoestima i la depressió que ocasiona l'obesitat en l'adult [21].

Conseqüències ginecològiques i obstètriques

La menarquia precoç s'ha associat amb un major risc d'avortament espontani a l'edat adulta [70]. El risc de síndrome de l'ovari poliquístic en l'adult també s'ha associat amb el sobrepès i l'obesitat a la infantesa i adolescència [116].

2.2.2.3. Conseqüències econòmiques

L'augment de la prevalença d'obesitat en una població està relacionada també amb un augment dels costs socioeconòmics [70]. I és que l'obesitat implica: (1) un costs directes per al sistema de salut, els quals inclouen els recursos aplicats en la gestió de l'obesitat i les afeccions causades o associades amb l'obesitat; (2) uns costs indirectes, relacionats amb una reducció de l'activitat econòmica a causa d'una malaltia –incloent la necessitat dels pares d'atendre als seus fills en cas que siguin els afectats- o associats a la mort prematura com a conseqüència de l'obesitat; i (3) uns costs intangibles, que farien referència als costs socials i personals associats a l'aspecte físic i la lluita contra l'obesitat [70].

És difícil avaluar tots els costs de forma objectiva, encara que en general s'ha suggerit que els costs de l'obesitat suposen un 2-7% del cost sanitari de cada país [70]. A Espanya, les dades de l'estudi Delphi [121] assenyalaren que el cost de l'obesitat suposa el 7% del cost sanitari del Sistema Nacional de Salut espanyol.

3. L'ADOLESCÈNCIA

L'adolescència és un període de transició entre la infantesa i l'edat adulta, una etapa decisiva en la vida humana a causa dels múltiples canvis que hi tenen lloc [61]. En aquest període apareix la pubertat. La pubertat fa referència als canvis corporals que tenen lloc de manera natural, com a resultat de l'evolució del creixement i el desenvolupament de l'organisme per a assolir la capacitat reproductora [122]. L'adolescència engloba la pubertat però també comprèn el desenvolupament psicològic i social que permet avançar cap a la maduració de la personalitat [122] i que condueixen a la vida adulta [123]. Per tot això, l'OMS limita l'adolescència cronològicament entre els 10 i els 19 anys [16,124], i la divideix en tres etapes: adolescència primerenca (10-13 anys), adolescència mitjana (14-15 anys) i adolescència tardana o joventut (16-19 anys) [124]. Tot i que cal tenir en compte la gran variabilitat que hi ha entre els nins i les nines en les edats d'inici i de finalització [122]. En general, l'inici de la pubertat comença abans en les nines que en els nins [61].

Canvis físics

En general, l'adolescència es caracteritza per una acceleració global del creixement i el desenvolupament, és a dir, ocorre un important augment de pes i d'alçada, i hi té lloc la maduració sexual [122]. El creixement es manifesta amb l'increment de pes i alçada i és intens en la pubertat. El pic màxim de creixement té lloc cap als 12 anys en les al·lotes i els 14 anys en els al·lots, i és el que es coneix com a estirada puberal, ja que suposa un augment de 9 a 12 cm d'alçada en un any, mentre que els quatre anys abans de produir-se aquest pic de creixement l'augment era de 5 a 6 cm per any [122]. L'any posterior a l'estirada puberal, la velocitat de creixement tendeix a baixar i generalment finalitza entre els 16-17 anys en les al·lotes i els 18-19 anys en els al·lots, encara que en algunes ocasions poden créixer fins als 21 anys [122]. Per altra banda, l'increment dels teixits que componen el cos en l'adolescència suposa un increment del pes que representa entre el 30% i el 50% del pes ideal de l'adult. Ara bé, cal tenir en compte les diferències existents en el ritme i la quantitat de creixement en un mateix grup d'adolescents de la mateixa edat i sexe [122].

Per altra banda, a la pubertat es desenvolupen els anomenats caràcters sexuals secundaris (aparició de pèl pubià i axil·lar, i desenvolupament mamari en les nines i dels testicles i el penis en els nins) i també varia la composició corporal [61,122]. El patró típic de composició corporal del sexe femení es caracteritza per un augment de la quantitat de MG corporal segons avança el grau de maduració sexual –proporcionalment més elevat que el guany de teixit muscular-, així com per unes espatlles més estretes que en els homes i unes cames més curtes en relació amb el tronc [61,123]. Per altra banda, en els nins disminueix el GC a mesura que avança la pubertat i, en canvi, assoleixen més quantitat de teixit muscular que les nines [61,122]; i també augmenten les dimensions de les espatlles i del rati cama-tronc [61,123]. Això explica que el cos de les al·lotes adquireixi unes formes més arrodonides, amb greix localitzat al pit, malucs i cuixes, mentre que el cos dels al·lots és més musculós [122]. Així, en l'adolescència té lloc una clara diferenciació en l'aspecte físic dels sexes [61,122].

Cal tenir en compte que la ràpida acumulació de teixit nou i els altres canvis vinculats al desenvolupament fan de l'adolescència un període d'increment de les necessitats nutricionals en comparació amb els anys de la infància [16] i l'edat adulta [122]. De fet, es pot afirmar que és l'etapa on cal més energia i hi ha una demanda més gran de nutrients [122]. Així, l'aportació adequada de nutrients en l'adolescent és un factor decisiu per a aconseguir un estat de salut i un ritme de creixement i desenvolupament òptims [122]. I a més, representa un paper important en la prevenció de malalties a l'edat adulta, entre elles l'obesitat [122].

Aspectes psicològics i socials

Molts canvis importants del desenvolupament psicològic i social es produeixen durant l'adolescència [16]. Apareixen una sèrie de tipus de comportament basats en uns valors característics d'aquesta etapa: independència adquirida recentment, costums dels seus coetanis, recerca de la pròpia identitat, IC i desig d'acceptació per part dels companys [123]. En general, els canvis que tenen lloc durant l'adolescència es produeixen a un ritme diferent per a cada individu i poden ser un període d'ansietat, o bé d'orgull [124]. Així, moltes de les respostes a la transició a l'etapa adulta poden incloure comportaments que tenen repercussions directes en la salut, com per exemple, les dietes, el consum de tabac, alcohol i drogues, l'activitat sexual i la violència [16]. En aquest aspecte, cal fer especial atenció a la influència dels mitjans de comunicació, ja que de vegades deformen la realitat donant idees equivocades sobre el sexe, el consum d'alcohol o de drogues i sobre l'èxit social lligat a un cos físicament perfecte [122]. La bellesa s'associa al fet de tenir un cos prim, de vegades fins a un punt incompatible amb la salut [122].

Algunes vegades, alguns patrons de comportament característics de l'adolescència provoquen desequilibris en el balanç energètic i l'estatus nutricional [61]. Així per exemple, obesitat, anorèxia, bulímia o dislipidèmia són alteracions que apareixen durant l'adolescència i freqüentment persisteixen en l'adult [61]. I no és perquè els adolescents no hagin rebut la informació suficient per a saber quins aliments són els que hauria de consumir i en què consisteix una alimentació saludable [123]. Sinó que en general, els adolescents donen més importància a l'opinió dels seus coetanis sobre l'alimentació [123]. Així, mentre alguns consideren les menjades com a un simple tràmit abans de passar a una altra activitat i no es preocupen pel que mengen; altres abusen dels *snacks* i el menjar ràpid, més atractius i d'alta densitat energètica. Finalment, un grup nombrós d'adolescents, interessats per una IC que concordi amb els ideals actuals, realitzen dietes restrictives i desequilibrades sense cap base nutricional, planificades per a ells mateixos [123].

Per tant, l'actitud de l'adolescent sobre el control de la seva pròpia ingesta pot provocar riscs nutricionals a curt i llarg termini. A més, els hàbits alimentaris que es consoliden durant aquesta etapa perduren la resta de la vida [122]. Per tots aquests motius, la proximitat de l'adolescència a la maduresa biològica de l'adult pot oferir oportunitats finals per a prevenir problemes de salut a l'etapa adulta [16].

4. LES ILLES BALEARS, UNA REGIÓ MEDITERRÀNIA: LA DIETA MEDITERRÀNIA

Les Illes Balears és una comunitat autònoma i província espanyola composta per les illes de l'arxipèlag balear (Mallorca, Menorca, Eivissa, Formentera i Cabrera), situat en el mar Mediterrani. La mítica trilogia mediterrània –blat, vinya i oli- es manté vigent en el seu paisatge i la dieta mediterrània (DM) ha estat el seu patró alimentari tradicional.

El patró tradicional de DM es caracteritza per un alt consum de verdures, llegums, fruites i fruits secs, i cereals (en el passat, en gran part sense refinar), un alt consum d'oli d'oliva però baixa ingesta de lípids saturats, una ingesta moderadament alta de peix (en funció de la proximitat del mar), una ingesta de baixa a moderada de productes làctics (majoritàriament en forma de formatge i iogurt), una baixa ingesta de carn i aus de corral, i una regular però moderada ingesta d'alcohol, principalment vi i generalment durant les menjades [162]. Però l'evidència epidemiològica suggereix que els patrons dietètics en els països del Mediterrani estan canviant ràpidament, amb un augment del consum de productes d'origen animal i greixos saturats, i una disminució de la ingesta de verdures.

Encara que el patró de la DM ha estat promogut com a model per a una alimentació saludable ja que s'ha associat amb un menor risc de vàries malalties cròniques no transmissibles i amb una supervivència prolongada [163-165], a Espanya totes les enquestes nutricionals realitzades confirmen un abandonament progressiu de la dieta mediterrània tradicional en els diferents grups d'edat, sobretot en les generacions més joves [166-170]. Així, per exemple, el patró de consum de la població adulta de les Illes Balears es troba en estat de transició caracteritzat per la pèrdua de la DM tradicional cap a un patró de dieta més occidental, amb un major consum de productes d'origen animal i greixos saturats i un menor consum de vegetals [171,172]. Per altra banda, en el 1998-2000, només el 46.4% dels nins i adolescents (2-24 anys) espanyols tenien una DM òptima [173]. En el 2004, els adolescents (12-17 anys) de Guadalajara (Espanya) mostraren només un 42.8% de mitjana d'adherència a la DM [174]. En el 2004-2005, un 6.7% de preadolescents xipriotes indicaren una alta adherència a la DM [175]. I en el 2007, només un 11.3% dels nins grecs i un 8.3% d'adolescents indicaren tenir hàbits alimentaris de la tradicional DM [176].

OBJECTIUS

A Espanya, la prevalença d'obesitat en nins i adolescents ha augmentat considerablement els darrers anys, arribant a una de les taxes més altes d'obesitat infantil d'Europa. L'única informació disponible sobre la prevalença de sobrepès i obesitat a les Illes Balears procedeix de l'Estudi de Nutrició de les Illes Balears (ENIB), un estudi epidemiològic transversal realitzat per l'equip de Nutrició Comunitària i Estrès Oxidatiu de la Universitat de les Illes Balears, gràcies al qual se sap que en els adults, el 1999-2000, hi havia una prevalença de sobrepès i obesitat del 27.8% i del 13.1%, respectivament [177]. Aquest estudi també identificà els factors predictors del sobrepès i l'obesitat en els adults, els quals foren el baix nivell educatiu, la inactivitat física i una dieta desequilibrada, molt energètica i rica en àcids grassos saturats. Respecte a la població juvenil balear, l'única referència disponible prové d'un estudi realitzat l'any 1998 per aquest mateix equip en adolescents de la ciutat de Palma, en el qual la prevalença d'obesitat i sobrepès va ésser, respectivament, del 6.5% i 9.7% en al·lots i del 3.5% i 12.3% en al·lotes de 17 anys [178].

Aquests resultats, la tendència a un increment de la prevalença de l'obesitat infantil al nostre país en els darrers anys, l'occidentalització progressiva dels hàbits nutricionals entre la població jove i l'augment de la població immigrant a la nostra societat, ens indueix a suposar que avui dia existeixen taxes elevades d'obesitat entre la població infantil i juvenil balear. Igualment, cal suposar que aquesta prevalença obeeix a l'acció de diversos factors, cadascun dels quals exerceix l'acció en diversa mesura.

Per tant, prèviament a l'aplicació d'estratègies d'intervenció dirigides a combatre el sobrepès i l'obesitat, és convenient conèixer la seva prevalença actual a la població juvenil de les Illes Balears i analitzar els seus factors predictors i la comorbiditat, emprant una metodologia homogènia que permeti la comparació amb altres estudis i poblacions. Aquest estudi i aquesta metodologia permetrà calibrar l'efectivitat de les estratègies d'intervenció aplicades i a aplicar.

1. OBJECTIU GENERAL

L'objectiu general d'aquesta Tesi Doctoral és conèixer la prevalença actual de sobrepès i obesitat en la població juvenil (12-17 anys) de les Illes Balears (2007-2008), els seus factors predictors (sociodemogràfics, estils de vida, qualitat de la dieta, activitat física, autopercepció de la imatge corporal) i comorbiditat i la seva evolució i tendència en els propers anys.

2. OBJECTIUS ESPECÍFICS

L'objectiu general es divideix en els següents objectius específics:

1. Determinar la prevalença de sobrepès i obesitat i els factors predictors d'obesitat en els adolescents de les Illes Balears

1.1. Analitzar les característiques antropomètriques per sexe i grups d'edat.

1.2. Determinar la prevalença de sobrepès i obesitat en els adolescents de les Illes Balears per sexe i grups d'edat (OMS 2007)

1.3. Determinar els factors predictors d'obesitat (OMS 2007, IMC≥P97) en els adolescents de les Illes Balears:

1.3.1. Característiques sociodemogràfiques i estils de vida

1.3.2. Diferències en la ingesta energètica i l'origen dietètic de l'energia

2. Comparar la prevalença de sobrepès i obesitat en els adolescents de les Illes Balears amb la prevalença estimada a altres països

3. Determinar la prevalença de normopès amb excés de GC i sobrepès amb una massa muscular incrementada

3.1. Comparar la prevalença de sobrepès (incloent obesitat) emprant diferents indicadors antropomètrics: IMC (OMS 2007 i IOTF), índex de massa grassa (IMG) i índex cintura:talla (ICT)

3.2. Determinar la prevalença dels grups obtinguts de la combinació dels indicadors antropomètrics IMC i IMG: normopès amb i sense excés de GC, sobrepès amb i sense excés de GC, i obesitat

4. Avaluar l'associació entre la freqüència de menjades amb diferents indicadors antropomètrics (IMC, IMG i ICT) i la qualitat de la dieta dels adolescents de les Illes Balears

4.1. Comparar les característiques antropomètriques en funció de la freqüència de menjades diàries per sexe

4.2. Comparar la ingesta energètica i l'origen dietètic de l'energia en funció de la freqüència de menjades diàries per sexe

4.3. Examinar les diferències en el consum de diferents grups d'aliments en funció de la freqüència de menjades diàries per sexe

4.4. Estudiar l'associació entre la freqüència de menjades diàries i diferents indicadors antropomètrics (IMC, IMG i ICT) amb la ingesta energètica

5. Anàlisi del sedentarisme i els seus factors determinants en els adolescents de les Illes Balears

5.1. Avaluar l'activitat física i l'estil de vida per sexe i edat

5.2. Descriure els factors determinants del comportament sedentari per sexe

5.3. Comparar les característiques antropomètriques dels adolescents d'acord a la pràctica d'activitat física per sexe

5.4. Examinar les diferències en el consum de diferents grups d'aliments entre els adolescents sedentaris i actius per sexe

6. Avaluar els patrons dietètics i la qualitat de la dieta dels adolescents de les Illes Balears

6.1. Analitzar els patrons dietètics i els seus factors determinants

6.2. Avaluar l'adequació de la dieta al patró alimentari de la DM (Índex de Qualitat de la Dieta Mediterrània, KIDMED) i els factors determinants d'una dieta pobrament Mediterrània

6.3. Avaluar la qualitat de la dieta dels adolescents de les Illes Balears (Diet Quality Index-International, DQI-I) i els seus factors determinants

7. Avaluar l'autopercepció de la imatge corporal en els adolescents de les Illes Balears

7.1. Analitzar l'autopercepció de la imatge corporal i l'actitud al control del pes en funció de l'adipositat global (IMC i IMG)

7.2. Examinar les diferències en el consum de diferents grups d'aliments d'acord a l'adipositat global (IMC i IMG) i l'autopercepció de la imatge corporal

8. Determinar la prevalença de SMet i els seus components en els adolescents de les Illes Balears

8.1. Determinar la prevalença de SMet i els seus components d'acord al criteri de l'ATP III adaptat per De Ferranti et al.[209]

8.2. Estudiar l'associació entre el SMet i els seus components i l'adherència a la DM

9. Estudiar la tendència de la prevalença de sobrepès i obesitat en els propers anys, així com en l'autopercepció de la imatge corporal i les actituds al control del pes en els adolescents de les Illes Balears

10. Proposar una nova classificació i un qüestionari que faciliti l'agrupació dels adolescents basada en l'adipositat global (IMC i IMG) i central (ICT) que sigui aplicable tant en la pràctica clínica com epidemiològica.

MATERIAL I MÈTODES

1. ESTUDI DE LA PREVALENÇA DE L'OBESITAT INFANTIL I JUVENIL A LES ILLES BALEARS (OBIB)

1.1. Plantejament general

L'estudi de la prevalença de l'obesitat infantil i juvenil a les Illes Balears (OBIB) és un estudi transversal multicèntric realitzat amb l'objectiu de conèixer la prevalença de sobrepès i obesitat en la població juvenil de les Illes Balears el 2007-2008, els seus factors predictors (qualitat de la dieta, AF, factors sociodemogràfics, estils de vida, perfil bioquímic o hemàtic i genètic), i la comorbiditat i tendència en els propers anys.

D'acord amb l'objectiu de l'estudi, es va elaborar un qüestionari que incloïa preguntes referents a l'estatus sociodemogràfic, estils de vida, estat de salut, autopercepció de la IC i hàbits dietètics. El qüestionari també incloïa un estudi nutricional i una avaluació antropomètrica que en una submostra es va complementar amb una avaluació bioquímica.

Aspectes ètics i legals

Aquest estudi es va realitzar d'acord amb les directrius establertes en la Declaració de Helsinki, i tots els procediments en éssers humans foren aprovats pel Comitè Ètic de les Illes Balears (Palma, Espanya).

1.2. Selecció dels participants, reclutament i aprovació

La selecció de la població d'estudi es va dur a terme per mitjà de vàries fases i amb un mostreig aleatori simple que va consistir, en primer lloc, en tenir en compte la localització (Palma, Calvià, Inca, Manacor, Maó, Eivissa, Llucmajor, Santa Margalida, S'Arenal i Sant Jordi de Ses Salines); i després, de forma aleatòria es varen assignar escoles dins cada poble i ciutat. Com la selecció de les escoles es va dur a terme mitjançant selecció aleatòria i compliment de quotes, i com la variable socioeconòmica es va considerar associada a la ubicació geogràfica i el tipus d'escola, es pot dir que aquesta variable es tingué en compte en l'assignació a l'atzar. Per altra banda, la mida de la mostra també va ser estratificada per edat i sexe.

Per a calcular el nombre d'adolescents a incloure en l'estudi i amb la finalitat de garantir una mostra representativa del conjunt d'adolescents de les Illes Balears, es va seleccionar la variable amb la major variació per a aquest grup d'edat a partir de les dades publicades en la literatura en el moment del plantejament de l'estudi; i que fou l'IMC [179]. Així, la mostra fou determinada per la distribució d'aquesta variable (IMC); amb un interval de confiança (CI) establert en el 95% i un error de ±0.25. El número de subjectes establert inicialment fou de 1,500 adolescents, el qual fou distribuït uniformement entre els pobles i ciutats, i proporcionalment distribuït per sexe i grup d'edat. La mostra fou de grans dimensions per tal d'evitar la pèrdua de la informació, fet que requerí fer el treball de camp a les aules de les escoles.

En cada escola, tots els adolescents de cada aula varen ser convidats a participar a l'estudi. A cada adolescent se l'hi donava prèviament una carta amb la informació i el propòsit de l'estudi per tal d'informar als seus pares o tutors legals. Després de rebre el consentiment informat i signat, els adolescents eren considerats per a la seva inclusió a l'estudi. El número final de subjectes inclosos a l'estudi fou de 1,231 adolescents (un 82% de participació). Les raons per no participar foren: (a) negació per part del subjecte a ésser entrevistat, i (b) falta d'autorització per realitzar l'entrevista per part dels pares o tutors legals.

Tots els adolescents que participaren a l'estudi foren convidats a proporcionar mostres de sang. Un total de 362 adolescents participaren a aquesta fase de l'estudi (30% de participació). Les raons per no participar en aquesta fase foren: (a) negació per part del subjecte a ésser punxat, i (b) falta d'autorització per realitzar l'entrevista per part dels pares o tutors legals. Cal fer notar que no hi ha va haver diferències estadísticament significatives entre les característiques (proporció d'edat i sexe, i antropometria) dels subjectes en la mostra final i la mostra de subjectes que proporcionaren mostres de sang. Les extraccions de sang també es varen realitzar a les escoles.

Per a avaluar l'evolució i tendència en els propers anys, dos anys acadèmics després es varen entrevistar 730 adolescents més (Palma, Santa Margalida, Maó i Eivissa).

1.3. Variables de l'estudi

1.3.1. Dades sociodemogràfiques i estils de vida

Dades sociodemogràfiques. Es va recopilar informació sobre l'edat de l'enquestat, el lloc de naixement (que es va definir com a procedent de les "Illes Balears"; "est d'Espanya", és a dir, de la costa mediterrània espanyola; "altres llocs d'Espanya"; i "altres països"), el nivell educatiu dels pares (que fou agrupat d'acord als anys d'estudi i el tipus de formació en: baix, <6 anys d'educació; mitjà, 6-12 anys; i alt, ≥12 anys), i nivell socioeconòmic dels pares (basat en l'ocupació dels pares i classificat en baix, mitjà i alt d'acord a la metodologia proposada per la Societat d'Epidemiologia Espanyola [180]).

Hàbits dietètics. L'enquesta també incloïa preguntes referides a l'hàbit d'esmorzar (sí; ocasionalment; no); les menjades que normalment realitzava l'enquestat (esmorzar; berenar a mitjan matí; dinar; berenar a mitja tarda; sopar; abans d'anar a sopar; altres); el temps dedicat a les tres menjades principals: esmorzar, dinar i sopar (<10 min; 10-20 min; >20 min); la distracció durant les menjades (mirar la TV; escoltar la ràdio; aixecar-se de la taula; conversar durant les menjades); i el consum de caramels i snacks salats (sí; ocasionalment; no). Cal dir que posteriorment, el número de menjades diàries es va recodificar en tres grups: ≤3, 4 i ≥5 menjades al dia. Per altra banda, la distracció durant el temps de les menjades fou reduïda a dues variables (prestar atenció als mitjans de comunicació -TV+ràdio- i altres).

Activitat física. L'AF va ser analitzada emprant la forma curta del Qüestionari Internacional d'AF (International Physical Activity Questionnaire, IPAQ) [181] i d'acord a la modificació per als adolescents (IPAQ-A) [182]. Els tipus d'AF analitzats foren: caminar, activitats d'intensitat moderada (ex: AF a l'escola), activitats d'intensitat vigorosa (ex: pràctica d'esports) i temps assegut al dia (emprat com a variable indicadora del temps dedicat a activitats sedentàries). D'acord a l'estudi AVENA (Alimentació i Valoració de l'Estat Nutricional en Adolescents) [183], també es va incloure informació del temps diari dedicat a dormir, mirar la televisió, emprar l'ordinador i les consoles, realitzar les tasques de l'institut i estudiar, així com el temps dedicat a altres activitats sedentàries durant el temps lliure.

L'AF analitzada per mitjà del qüestionari IPAQ es va correlacionar amb el nivell d'AF (*Physical Activity Level*, PAL) d'acord a l'estimació del coeficient d'activitat individualitzat. Cada subjecte va ser classificat segons el seu valor de PAL [184] com a: sedentari (PAL ≥1.0<1.4), poc actiu (PAL ≥1.4<1.6), actiu (PAL ≥1.6<1.9), i molt actiu (PAL ≥1.9). Per tal de simplificar i facilitar alguns anàlisis, en ocasions els subjectes foren agrupats en "no actius" (sedentaris o poc actius) i "actius" (actius o molt actius). Per altra banda i d'acord al temps setmanal dedicat a AF, els adolescents que dedicaren menys de 300 min setmanals a AF moderada i/o vigorosa també es varen considerar com a inactius [185,186].

Hàbits no saludables. Es va recopilar informació sobre el consum de tabac (sí; ocasionalment, <1 cigarret al dia; no), el consum d'alcohol (freqüentment; ocasionalment, <1 beguda alcohòlica a la setmana; no), i el patró d'AF.

Estat de salut. Es va demanar informació sobre la presència de malalties cròniques (no en tinc; diabetis; hipertensió; excés de pes; colesterol; celiaquia (intolerància al gluten); intolerància a la lactosa; altres).

1.3.2. Mesures antropomètriques

Les mesures antropomètriques realitzades en aquest estudi foren: pes, talla, perímetres, plecs cutanis i tensió arterial. A partir d'aquestes mesures es varen calcular diversos indicadors antropomètrics com l'IMC, l'índex cintura/maluc (ICM), l'ICT, el percentatge de MG i de MLG.

Talla. La talla fou mesurada emprant un antropòmetre mòbil (Kawe 44444, Asperg, Alemanya) mantenint el cap dels subjectes en el pla de Frankfurt i amb una precisió mil·limètrica.

Pes corporal. El pes corporal es va determinar amb els subjectes lleugers de roba i sense sabates amb una bàscula digital (Tefal, sc9210, França) d'una precisió de 100g.

Perímetres. Els perímetres es mesuraren amb una cinta mètrica no-extensible i amb una precisió de 0.1 cm (Kawe, 43972, França). Per a realitzar aquestes mesures es va demanar als subjectes que es mantinguessin drets, en posició relaxada i amb els peus junts. Els perímetres mesurats foren: braquial, cintura, maluc i cuixa. El perímetre braquial fou mesurat en el punt mitjà de l'húmer. El perímetre de la cintura es va mesurar com la menor circumferència horitzontal entre els marges costals i la cresta ilíaca, i en mínima respiració. El perímetre del maluc es va mesurar al major nivell dels trocànters (la part més ampla del maluc). El perímetre de la cuixa va ser mesurat per sota del plec cutani.

Plecs cutanis. Es van mesurar el plec del tríceps i el subescapular amb un lipocalímetre Holtain (Tanner/Whitehouse, Crosswell, Crymych, Regne Unit). De cada plec es van fer un total de tres mesures a la part dreta i es va emprar la mitjana d'aquestes mesures.

Índex de massa corporal. El pes i la talla es van emprar per a calcular l'IMC (kg/m^2). Per tal de facilitar la comparabilitat entre estudis, els subjectes foren classificats emprant gràfiques d'IMC de referència internacionals: les gràfiques publicades per l'OMS l'any 2007 [34], i els criteris IOTF [13]. Quan s'empraren les gràfiques de referència de l'OMS es varen emprar dos punts de tall diferents per a definir l'obesitat, els percentils 95 i 97 per a edat i sexe. En conseqüència, la definició del sobrepès també es va veure afectada, i els adolescents classificats amb sobrepès foren aquells amb un IMC≥P85<P95 i IMC≥P85<P97, segons el punt de tall emprat per a definir l'obesitat.

Greix corporal. El GC (%) es va calcular d'acord a les equacions de Slaughter et al. [69], ja que aquestes equacions han estat proposades com les més precises per a l'estimació del percentatge de GC a partir dels plecs tricipital i subescapular en la població adolescent [68]. Posteriorment, es va calcular l'IMG (kg/m^2), una relació entre el GC i la talla que permet avaluar els paràmetres de la composició corporal eliminant les diferències en el GC associades a la talla [187] i més precís que l'IMC per a la detecció de sobrepès [31]. Els punts de tall emprats per a classificar els adolescents segons si tenien un GC normal o en excés foren els proposats prèviament per Alvero-Cruz et al. [31]: 4.58 kg/m^2 en els al·lots i 7.76 kg/m^2 en les al·lotes.

Índex cintura/talla i cintura/maluc. Mentre que l'IMC i l'IMG generalment són emprats com a mesura d'obesitat general, l'ICT i l'ICM són relacions que s'empren com a mesura de sobrepès i obesitat central, més relacionada amb les malalties metabòliques. Es recomana que tant en nins com adults, l'ICT es mantingui inferior a 0.5, punt de tall emprat en aquest estudi [67].

Tensió arterial. La tensió arterial es va mesurar automàticament (Omron, M4-I, Healthcare Co. Ltd., Japan) amb una precisió de 1 mmHg. La mesura es va realitzar al braç esquerre amb els subjectes asseguts i amb el palmell de la mà cap a dalt. Es varen realitzar un total de dues mesures separades per 5 min i es va emprar la mitjana obtinguda per a cada subjecte. Si la diferència entre la primera i la segona mesura era ≥10 mmHg per a la tensió sistòlica i/o ≥6 mmHg per a la tensió diastòlica, es va realitzar una tercera mesura, i en aquest cas, es va emprar la mitjana de les tres mesures realitzades.

1.3.3. Avaluació dietètica

L'avaluació dietètica es va efectuar mitjançant l'aplicació de dos recordatoris de 24 hores no consecutius, un qüestionari semiquantitatiu de freqüència de consum d'aliments (QFC) prèviament validat [188] i aplicat a altres estudis i enquestes a la població espanyola [170,172,178,189,190] i el qüestionari KIDMED [191].

Recordatori de 24 hores. La ingesta d'energia i nutrients es va determinar a partir dels resultats mitjans dels dos recordatoris de 24 hores. La conversió de la ingesta d'aliments en nutrients es va realitzar mitjançant un programa informàtic (Alimenta®, NUCOX, Palma, Espanya) basat en les taules de composició d'aliments espanyoles [192,193] i europees [194], i complementat amb dades de composició d'aliments disponibles per als aliments de Mallorca [195]. Aquest programa informàtic conté dades referents a aliments i plats de consum habitual, i proporciona informació sobre el contingut de 35 nutrients, a més dels continguts d'energia, alcohol i aigua, per a cada aliment i recepta.

La identificació dels adolescents que informaren incorrectament la seva ingesta (*mis-reporters*) es va dur a terme mitjançant l'avaluació de la relació entre la ingesta energètica i la taxa metabòlica basal (IE/TMB) [196]. Una ratio IE/TMB<0.92 als al·lots i <0.85 a les al·lotes fou considerat infraestimació [196], mentre que una ratio IE/TMB≥2.4 fou considerat sobreestimació [197,198]. En total hi va haver un 20% d'infraestimació i un 2% de sobreestimació.

Qüestionari semiquantitatiu de freqüència de consum d'aliments (QFC). El patró habitual de consum d'aliments de la població adolescent estudiada es va determinar mitjançant un QFC prèviament validat [188] que incloïa 145 aliments (118 del QFC original i validat, més els aliments més característics de les Illes Balears per tal de facilitar la resposta a l'entrevistat), i organitzat per tipus d'aliments i patró alimentari. El consum es va expressar com la freqüència diària, setmanal o mensual dels diferents aliments o grups d'aliments en les racions estàndards. Els 145 aliments s'agruparen en 29 grups d'aliments que poden tenir importància pràctica en la dieta diària i en la pràctica clínica entre els joves del Mediterrani [199,200].

Qüestionari KIDMED. El qüestionari KIDMED permet avaluar l'adequació de la dieta al patró alimentari de la DM en nins i adolescents [191]. Aquest test consta d'un total de 16 preguntes i té una puntuació de 0 a 12. D'acord a la puntuació KIDMED, la qualitat de la dieta dels individus es classifica en tres nivells: pobra (≤3); intermèdia, és a dir, que ha de millorar el patró alimentari (4-7); i bona (≥8).

1.3.4. Autopercepció de la imatge corporal i actituds en el control del pes

L'autopercepció de la IC es va mesurar amb l'escala de Stunkard [201]. Aquesta escala consisteix en 9 dibuixos de la silueta del cos (de forma separada, femenina i masculina), que van incrementant progressivament el percentatge de sobrepès, essent la figura 1 la més prima i la figura 9 la més grassa. Als participants se'ls hi va demanar que identifiquessin una de les 9 siluetes d'acord a les següents preguntes: "Quina silueta se sembla més a tu?" i "Quina silueta t'agradaria tenir?". La diferència entre la IC percebuda i la imatge desitjada es va emprar per a determinar el nivell d'insatisfacció amb la IC. Els valors diferents de zero representen una insatisfacció amb la IC percebuda. Així, mentre que un valor positiu és indicatiu del desig de tenir una silueta menor que la percebuda, un valor negatiu reflexa el desig dels participants a ser més grans que la silueta percebuda

[202,203]. Altres qüestions també considerades foren la preocupació amb el pes (no; un poc; molt), la pràctica de dietes per a baixar de pes (sí; no) i el mètode emprat per a perdre pes (dieta i/o AF).

1.3.5. Avaluació bioquímica: determinació de la glucèmia, triglicèrids, colesterol total i colesterol HDL

S'obtingueren mostres de sang d'una submostra de la població entrevistada (n=362, 30% de la població). Les mostres de sang s'obtingueren de la vena antecubital amb vacutainers adequats a les 8:00 h del matí, després de 12 hores de dejuni. La glucèmia, els nivells de triglicèrids (TG), colesterol total i colesterol HDL foren determinats per mètodes colorimètrics emprant un autoanalitzador DAX-72 (Technicon, Bayer) [204,205].

2. ANÀLISI DE LES DADES

2.1. Determinació de la prevalença de sobrepès i obesitat i els factors predictors en la població adolescent de les Illes Balears

La determinació de la prevalença de sobrepès i obesitat es va dur a terme emprant les gràfiques de referència internacionals de l'OMS publicades l'any 2007 [34] i les gràfiques IOTF [13]. Per a determinar els factors de risc implicats en la generació d'obesitat en aquesta població adolescent es va comparar el perfil sociodemogràfic, l'estil de vida i l'hàbit dietètic dels individus obesos (IMC≥P97) amb els individus no-obesos (IMC<P97).

2.2. Comparació de la prevalença de sobrepès i obesitat en els adolescents de les Illes Balears amb la prevalença estimada a altres països

Amb l'objectiu de comparar la prevalença de sobrepès i obesitat en els adolescents de les Illes Balears amb la prevalença estimada a altres països i regions, es va realitzar una revisió sistemàtica de la literatura sobre la prevalença de sobrepès i obesitat en els adolescents (10-19 anys). La recerca es va realitzar en el Medline introduint els termes-MeSH següents: 'overweight'; 'obesity'; 'prevalence'; 'adolescent'. Resultat d'aquesta recerca foren seleccionats un total de 2,307 articles publicats en les bases de dades fins el dia 13 de setembre de 2011. Per tal d'ampliar la recerca, també es van revisar les dades de prevalença de sobrepès i obesitat en nins i adolescents de la pàgina web oficial de la IOTF (http://www.iaso.org/iotf/). Els criteris d'inclusió per a seleccionar els articles foren: (1) estudis transversals realitzats els darrers 11 anys acadèmics (1999-2010) –els estudis que no indicaven l'any d'entrevista foren eliminats-; (2) dades representatives a nivell nacional i/o regional –els articles realitzats en ciutats, o únicament en àrees rurals o urbanes també foren exclosos-; (3) pes i talla mesurats objectivament; (4) resultats presentats per sexe; (5) dades de sobrepès i obesitat presentades per separat; (6) definició de sobrepès i obesitat emprant les gràfiques CDC-2000 [33], IOTF [13] i/o OMS-2007 [34]; i (7) només es varen incloure estudis escrits en anglès, castellà, italià o portuguès. A més, cal indicar que quan els països o regions posseïen més d'un estudi amb dades de sobrepès i obesitat en la població adolescent, en aquesta revisió es va considerar l'estudi més recent.

Un total de 38 estudis (37 articles i un informe de salut nacional) compliren els criteris d'inclusió. Finalment, 34 països foren representats en aquesta revisió sistemàtica: 23 països amb dades representatives a nivell nacional i 11 països representats únicament per dades regionals.

2.3. Determinació de la prevalença de normopès amb excés de GC i sobrepès amb una massa muscular incrementada en la població adolescent de les Illes Balears

Com ja s'ha comentat anteriorment, l'IMC té una sèrie de limitacions per a diagnosticar un excés de GC en el rang baix i mitjà de distribució de l'IMC [9,25]. Amb la finalitat d'estimar la prevalença d'adolescents amb un IMC normal però amb un excés de GC i aquells amb un IMC mitjà però relacionat amb una massa muscular incrementada, els adolescents foren classificats en funció de la combinació del seu IMC i IMG, d'acord a la taula 11. Cal destacar que actualment és difícil excloure l'IMC de la definició de normopès, sobrepès i obesitat.

Taula 11. Classificació dels individus d'acord al seu IMC i IMG[1,2]

IMG / **IMC**	*<4.58 kg/m² al·lots* *<7.76 kg/m² al·lotes*	*≥4.58 kg/m² al·lots* *≥7.76 kg/m² al·lotes*
IOTF: IMC<25 kg/m² *OMS-2007: <P85*	Normopès sense excés de GC	Normopès amb excés de GC
IOTF: IMC≥25 kg/m² - <30 kg/m² *OMS-2007: ≥P85 - <P95*	Sobrepès sense excés de GC	Sobrepès amb excés de GC
IOTF: ≥30 kg/m² *OMS-2007: ≥P95*	*	Obesitat

Abreviatures: IMC, índex de massa corporal; IMG, índex de massa grassa; P, percentil; GC, greix corporal.
Per a la classificació dels individus s'indiquen [1]els punts de tall d'IMC de les gràfiques de referència internacionals emprats (IOTF [13] i OMS-2007 [34]) per a definir normopès, sobrepès i obesitat; i [2]els punts de tall d'IMG emprats per a definir excés de greix corporal, proposats per Alvero-Cruz et al. [31].
*En els nivells extrems, l'IMC es correlaciona bé amb l'excés de greix corporal [10,12,19].

De la combinació de l'IMC i l'IMG s'obtingueren un total de 5 grups: (1) el normopès sense excés de GC; (2) el normopès amb un excés de GC, és a dir, individus amb una MLG disminuïda i una MG incrementada; (3) el sobrepès sense excés de GC, que incloïa els individus amb un IMC incrementat a causa que la seva massa muscular estava incrementada; (4) el sobrepès amb excés de GC; i (5) l'obès.

Cal esmentar en aquest apartat que, per tal de facilitar algunes anàlisis reduint les limitacions de l'IMC en la definició de sobrepès i normopès, en ocasions els adolescents es varen classificar en tres grups: (1) adolescents sense excés de GC, que incloïa a aquells al·lots amb un IMG<4.58 kg/m^2 i al·lotes amb un IMG<7.76 kg/m^2; (2) adolescents amb sobrepès i excés de GC, en cas de tenir un IMC per edat i sexe ≥25-<30 kg/m^2 i un IMG≥4.58 kg/m^2 en el cas dels al·lots, i un IMG≥7.76 kg/m^2 en el cas de les al·lotes; i (3) adolescents amb obesitat, en cas de tenir un IMC per edat i sexe ≥30 kg/m^2.

2.4. Avaluació de l'associació entre la freqüència de menjades amb diferents indicadors antropomètrics (IMC, IMG i ICT) i la qualitat de la dieta dels adolescents de les Illes Balears

Per analitzar més a fons la freqüència de menjades diàries –un dels factors de risc per a l'obesitat identificat en els al·lots i les al·lotes adolescents de les Illes Balears-, es va analitzar l'adipositat global (mitjançant els indicadors IMC i IMG) i central (ICT) dels adolescents, el consum d'aliments i la qualitat de la dieta segons la freqüència de menjades diàries (≤3, 4 o ≥5 menjades per dia).

2.5. Anàlisi del sedentarisme i els seus factors determinants en els adolescents de les Illes Balears

L'anàlisi del sedentarisme es va realitzar d'acord al temps setmanal dedicat a AF. Per a determinar els factors de sedentarisme en aquesta població adolescent es va comparar el perfil sociodemogràfic, l'estil de vida, la qualitat de la dieta (d'acord a la DM) i l'autopercepció de la IC dels adolescents que dedicaven menys de 300 min setmanals a AF moderada/vigorosa amb els individus actius (≥300 min setmanals).

També es van analitzar les diferències en el consum de diferents grups d'aliments d'acord al patró d'AF. Així, es van determinar els grups d'aliments de major consum en els individus sedentaris (AF <300 min setmanals) respecte als individus actius (AF ≥300 min setmanals).

2.6. Avaluació dels patrons dietètics i la qualitat de la dieta dels adolescents de les Illes Balears

2.6.1. Avaluació dels patrons dietètics

Amb la tècnica estadística de reducció de dades "anàlisi factorial", es van determinar els principals patrons dietètics dels adolescents de les Illes Balears. També es va analitzar els factors sociodemogràfics i estils de vida determinants dels patrons dietètics obtinguts.

2.6.2. Càlcul d'adherència a la Dieta Mediterrània

La qualitat de la dieta balear es va avaluar en base a la seva similitud al patró de la Dieta Mediterrània. Aquesta es va calcular mitjançant l'aplicació d'un índex (*Mediterranean Diet Score*, MDS) que avalua el consum de nou aliments típics de la Dieta Mediterrània: consum elevat de verdures, fruites i fruits secs, llegums, cereals, peix, àcids grassos monoinsaturats (en relació als àcids grassos saturats), consum moderat d'alcohol i baix consum de productes càrnics i làctics.

L'adequació de la dieta al patró alimentari de la DM també fou avaluada a partir del qüestionari KIDMED, i fou classificada en tres nivells: pobra (≤3); intermèdia, és a dir, necessita millorar el patró alimentari (4-7); i bona (≥8).

2.6.3. Càlcul de l'Índex Internacional de qualitat de la dieta (DQI-I)

L'índex Internacional de Qualitat de la Dieta (DQI-I) [206] va ser creat amb l'objectiu de ser aplicable de forma internacional i avaluar la qualitat de la dieta de països desenvolupats i en vies de desenvolupament; i més concretament, de poblacions en procés de transició nutricional. El DQI-I avalua la qualitat de la dieta tenint en compte simultàniament quatre criteris (varietat, adequació, balanç i moderació). La varietat en la dieta s'avalua com la varietat en general i la varietat de les fonts proteiques. L'adequació avalua la ingesta adequada dels elements que es requereixen per a protegir de la desnutrició i dels trastorns derivats de la seva manca. La categoria moderació avalua la ingesta d'aliments i nutrients relacionats amb malalties cròniques i que poden necessitar restricció. I l'equilibri general és una categoria que examina el balanç global de la dieta en termes de proporcions de les fonts d'energia i la composició d'àcids grassos. Cada una d'aquestes quatre categories principals es compon a la vegada de subcategories i el rang total de l'índex va de 0 (mínima qualitat) a 100 (màxima qualitat). En aquest estudi es va emprar la modificació del DQI-I de Mariscal-Arcas et al. [207] realitzada a partir de la modificació per Tur et al. [208] per a poder aplicar-se a poblacions mediterrànies.

2.7. Avaluació de l'autopercepció de la imatge corporal i l'actitud al control del pes corporal en els adolescents de les Illes Balears

Es va analitzar l'autopercepció de la IC i les seves actituds sobre el control del pes corporal d'acord a l'adipositat global (IMC i IMG). També es van analitzar les diferències en la freqüència de consum de diferents grups d'aliments dels adolescents amb excés de GC i insatisfets amb la seva IC amb els seus companys també amb excés de GC però satisfets i els companys més prims.

2.8. Determinació de la prevalença de síndrome metabòlica i els seus components en els adolescents de les Illes Balears

Es va determinar la prevalença de SMet en una submostra de la població entrevistada (n=362, 30% de la població). La definició de SMet emprada en aquest estudi fou la definició de l'ATPIII modificada per De Ferranti et al. [209]. Així, els participants que compliren tres o més dels cinc criteris següents foren definits com a que tenien SMet: trigliceridèmia ≥1.1 mmol/L; HDL-colesterol <1.3 mmol/L (en el cas dels al·lots de 15-17 anys s'aplica un valor <1.17 mmol/L); glucèmia sèrica en dejuni ≥6.1 mmol/L; perímetre de la cintura (cm) >P75 per edat i sexe [36]; i tensió arterial sistòlica o diastòlica (mmHg) >P90 per edat, sexe i talla [210].

2.9. Estudi de la tendència de la prevalença de sobrepès i obesitat en els propers anys, així com en l'autopercepció de la imatge corporal i les actituds al control del pes en els adolescents de les Illes Balears

Es van avaluar diferències en el sobrepès i l'obesitat, l'autopercepció de la IC i les actituds al control del pes entre les dues poblacions d'adolescents entrevistades amb una diferència de 2 anys acadèmics.

2.10. Proposar una nova classificació per a l'agrupació dels adolescents en funció de la seva adipositat global (IMC i IMG) i central (ICT) aplicable tant en la pràctica clínica com epidemiològica

De l'anàlisi dels resultats obtinguts, es va proposar una nova classificació que podria reduir les limitacions de l'IMC en la identificació dels adolescents amb un excés de GC i amb una major adipositat central i, per tant, amb un major risc de malalties metabòliques.

Aquesta Tesi s'ha pogut realitzar gràcies a la concessió d'una ajuda en forma de beca predoctoral del Programa Nacional de Formació de Professorat Universitari (FPU) del Ministeri de Ciència i Innovació (MICINN) (ref. AP2007-01370).

També s'ha comptat amb el suport de diferents institucions per a dur a terme cada un d'aquests projectes:

- *Estudio de la prevalencia de la obesidad infantil y juvenil en las Islas Baleares (Estudio OBIB)*, finançat pel *FIS* (ref. 05-1276).
- *Prevalencia de la obesidad en las Islas Baleares: su relación con el estrés oxidativo y los mediadores de la inflamación (Estudio OBEX)*, finançat pel *FIS* (ref. 08-1259).
- *Incorporación del Grupo de Nutrición Comunitaria y Estrés Oxidativo-Islas Baleares (NUCOX-IB) a la Red PREDIMED (Alimentación saludable en la prevención primaria de enfermedades crónicas)*, finançat pel *FIS* (ref. RD06/0045/1004).

RESULTATS I DISCUSSIÓ

RESULTS AND DISCUSSION

Manuscrit I

Prevalence and risk factors for obesity in Balearic Islands adolescents.

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Prevalence and risk factors for obesity in Balearic Islands adolescents

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The aim of this work was to assess the prevalence and risk factors of obesity in the Balearic Islands' adolescents. A cross-sectional nutritional survey was carried out in the Balearic Islands (2007–2008). A random sample (*n* 1231) of the adolescent population (12–17 year old) was interviewed. Anthropometric measurements, two non-consecutive 24 h recalls and a general questionnaire incorporating questions related to sociodemographic and lifestyle variables including the physical activity questionnaire were used. The prevalence of overweight was 19·9 % (boys) and 15·5 % (girls), and obesity 12·7 % (boys) and 8·5 % (girls). The main risk factors associated with a higher prevalence of obesity were low parental education level (boys OR: 3·47; 95 % CI: 1·58, 7·62; girls OR: 3·29; 95 % CI: 1·38, 7·89), to skip meals (boys OR: 4·99; 95 % CI: 2·1, 11·54; girls OR: 2·20; 95 % CI: 0·99, 4·89), age (12–13-year-old boys; OR: 2·75; 95 % CI: 1·14, 6·64), attention to mass media (television (TV) + radio; boys OR: 1·50; 95 % CI: 0·81, 2·84; girls OR: 2·06; 95 % CI: 0·91, 4·68), short sleep (boys OR: 3·42; 95 % CI: 0·88, 13·26), low parental socioeconomic status (girls OR: 3·24, 95% CI: 1·04, 10·05) and smoking (girls OR: 2·51; 95 % CI: 0·88, 7·13). A programme of action including school healthy education and promotion programmes targeted at parents and adolescents are needed. These programmes may be mainly focused to increase educational level, to make the adolescents to be aware of to skip meals and to smoke are not appropriate methods to reduce the risk of obesity, but the usefulness is to do not eat while watching TV, to sleep 8–10 h/d and to be physically active.

Adolescents: Obesity: Overweight: BMI: Balearic Islands

The prevalence of overweight and obesity among children and adolescents has risen greatly worldwide, making them one of the most serious public health problems in this age group and in adulthood[1]. Childhood and adolescent excessive weight (overweight and obesity) are associated with significant immediate and long-term health risks[1,2]. About 70 % of obese adolescents grow up to become obese adults[2]. Childhood and adolescent obesity predict obesity in adulthood and increase the risk of adult morbidity and mortality[1,3].

Although there are both genetic and environmental causes of obesity, the increase in prevalence of obesity worldwide is likely to be more closely associated with changes in environmental factors[2]. Sociocultural factors as parental occupational status, maternal level of education, cultural and/or religious habits and the role of family and patterns of beauty are factors that have a strong influence on eating habits in adolescents[4]. Changes on physical activity patterns in youth as a result of adopting a major inactive lifestyle, increasing time spent watching television (TV), playing video games and Internet are also associated with obesity increases[1,2].

The aim of present study was to assess the prevalence and risk factors of obesity in adolescents of the Balearic Islands, a Mediterranean region.

Methods

Study design

The study is a population based cross-sectional nutritional survey carried out in the Balearic Islands between 2007 and 2008.

Selection of participants, recruitment and approval

The target population consisted of all inhabitants living in the Balearic Islands aged 12–17 years. The sample population was derived from residents aged 12–17 years registered in the scholar census of the Balearic Islands. The theoretical sample size was set at 1500 individuals in order to provide a specific relative precision of 5 % (type I error = 0·05; type II error = 0·10), taking into account an anticipated 70 % participation rate. The sampling technique included stratification according to municipality size, age and sex of inhabitants, and random selection within subgroups, with Balearic Islands' municipalities being the primary sampling units, and individuals within these municipalities comprising the final sample units. The interviews were performed at the schools. The final sample size was 1231 individuals (82 % participation). The reasons to not participate were (a) the subject declined to be interviewed; (b) the parents did not authorise the interview.

Abbreviations: EI, energy intake; PAL, physical activity level; TV, television.

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Anthropometric measurements

Height was determined using a mobile anthropometer (Kawe 44 444, Asperg, Germany) to the nearest millimetre, with the subject's head in the Frankfurt plane. Body weight was determined to the nearest 100 g using a digital scale (Tefal, sc9210, Rumilly, France). The subjects were weighed in bare feet and light underwear, which was accounted for by subtracting 300 g from the measured weight. Triceps and subscapular skinfold thickness were measured using a Holtain skinfold calliper (Tanner/Whitehouse, Crosswell, Crymych, UK), and the mean of three measurements (right arm) was used, and used to calculate body fat as described previously[5]. Anthropometric measurements were performed by well-trained observers in order to avoid the inter-observer coefficients of variation. According to the WHO growth standards for children and adolescents, the prevalence of overweight (BMI ≥ P85 < P97) and obesity (BMI ≥ P97) was age- and sex-specific calculated[6]. Waist circumference and waist:hip ratio were calculated according to cut-off limits described elsewhere[7].

Energy and nutrient intakes

For energy intake (EI), two non-consecutive 24 h diet recalls were obtained from the participants. Well-trained dietitians administered the recalls and verified and quantified the food records. To estimate volumes and portion sizes, the household measures found in the subjects' own homes were used. Conversion of food into nutrients was made using a self-made computerised program based on Spanish[8,9] and European[10] food composition tables and complemented with food composition data available for Majorcan food items[11]. Misreporters were determined using the Black's modification[12] of the Goldberg *et al.* cut-off[13] for EI. To define underreporting, the lower cut-off value for the ratio between EI and BMR (EI/BMR) was calculated for boys and girls separately as 3 SD below the mean of the ratio between total energy expenditure[14] and BMR (total energy expenditure/BMR) for the 99 % lower confidence limit. With this calculation, the variation of EI, BMR and energy requirements are taken into account. In large studies ($n > 500$), the number of days of dietary assessment has a negligible effect on the cut-off values, and for measured BMR and 2 d of assessment, the coefficient variation used was 28·74 %[12]. The cut-off values were >1·56 EI/BMR for boys and >1·41 for girls. An EI/BMR ≥ 2·4 was considered to represent overreporting[15,16]. Underreporters (20 %) and overreporters (2 %) were excluded from the analysis of dietary patterns.

General questionnaire

The study population was divided into two categories according to their BMI: obese (BMI ≥ P97) and non-obese (BMI < P97). A questionnaire incorporating the following questions was used: age group; region of origin (defined as being born in the Balearic Islands, East of Spain as a representative of the Spanish Mediterranean coast, other parts of Spain and other countries); parental educational level (grouped according to years and type of education: low, <6 years at school; medium, 6–12 years of education; high, >12 years of education); parental socioeconomic level (based on the occupation of parents and classified as low, medium and high, according to the methodology described by the Spanish Society of Epidemiology[17]).

Information about smoking habits, alcohol intake, sweets and salty snacks (potato chips, maize chips, ready-to-eat pop maize, pork rinds, potato sticks, extruded snacks and cheese puffs) consumption and breakfast habits were collected as described: smoking habit (no; yes; occasionally; <1 cigarette/d); alcohol consumption (no; frequently; occasionally; <1 drink/week); sweets and salty snacks consumption (yes; occasionally; no); breakfast daily (yes; occasionally; no).

The number of daily meals was calculated using the total of eating occasions that subjects declared to made among the following: breakfast; mid-morning snack; lunch; mid-afternoon snack; dinner; before going to sleep; others. Three groups of eating frequency were considered: ≤3; 4; ≥5 times/d.

Distraction during mealtime was studied using different possibilities: (1) watching the TV; (2) listen to the radio; (3) get up from the table; (4) conversation during mealtime. These variables were joined and expressed as (1) attention to mass media (TV + radio); (2) others.

Physical activity was evaluated according to the guidelines for data processing and analysis of the international physical activity questionnaire[18] in the short form and its specific modification for adolescents (IPAQ-A)[19]. The specific types of activity assessed were walking, moderate-intensity activities (i.e. physical activity at school) and vigorous-intensity activities (i.e. sport practice) and an additional question about sitting time was using as an indicator variable of time spent in sedentary activity. The questionnaire also included information on hours per day of TV viewing, computer use, video games, another leisure time physical activity practice and typical sleep duration to the nearest 10 min. The physical activity assessed by the international physical activity questionnaire was correlated with physical activity level (PAL) according to the estimation of the individualised activity coefficient. Each subject was classified taking into account its PAL value[20] as: sedentary (PAL ≥ 1·0 < 1·4); low active (PAL ≥ 1·4 < 1·6); active (PAL ≥ 1·6 < 1·9); very active (PAL ≥ 1·9). Each subject was then classified into no active (sedentary or low active) and active (active or very active).

Differences in EI between BMI < P97 and BMI ≥ P97 subjects were also studied. Total EI (MJ), energy (kJ) per kg of weight, energy (kJ) per kg of lean body mass and percentage of energy from macronutrients were taken into consideration for this analysis.

Statistics

Analyses were performed with SPSS version 16.0 (SPSS, Inc., Chicago, IL, USA). All tests were stratified by sex. Significant differences in prevalence were calculated by means of χ^2. Difference between groups' means was tested using ANOVA. Logistic regression models with the calculations of corresponding adjusted OR and 95 % CI were used to examine possible differences between those with BMI below or above P97. Univariate analysis was first carried out for all the sociodemographic and lifestyle variables that could be associated with the frequency of obesity. Any factor that was significantly associated was considered as a candidate for the multivariate model. Multiple logistic regression analyses were used to simultaneously examine the effect of different sociodemographic and lifestyle variables on the prevalence of obesity. The study of possible differences in food patterns between those obese and non-obese was adjusted by confounding factors. All correlations were investigated with Spearman's rank correlation coefficient (r). Level of significance for acceptance was $P<0{\cdot}05$.

Ethics

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

Results

The overall prevalence of overweight and obesity estimated for the adolescent population of the Balearic Islands was 17·5 and 10·4 %, respectively (Table 1). Boys had a higher prevalence of overweight and obesity than girls. Excessive weight considered overall (BMI ≥ P85) was 32·6 % in boys and 24·0 % in girls. Prevalence of obesity (BMI ≥ P97) was higher in boys (12·7 %) than girls (8·5 %), and this difference was evident at 12–13 years old. Boys also showed higher waist circumference values and waist:hip ratio than girls, and girls showed higher hip circumference than boys after they were 14 years old. More girls than boys were above the cut-off values established for the waist circumference indicators of cardiovascular risk. Girls showed higher body fat mass than boys.

The univariate analysis with sociodemographic and lifestyle variables (Table 2) showed that the risk of obesity was associated with parental education level and number of daily meals in both sexes, age in boys, and parental socioeconomic status and current smoking habit in girls. The multivariate analysis showed that the risk of obesity increased in younger boys and in girls who were not active, in boys and girls who usually distracted during mealtime by means of mass media (TV + radio) and in boys who sleep <7 h daily, despite the lack of

Table 1. Anthropometric characteristics and prevalence of obesity and overweight of study participants
(Mean values and standard deviations or percentages)

	Total (n 1231)		Boys (n 574)		Girls (n 657)		
	Mean	SD	Mean	SD	Mean	SD	P
BMI (kg/m^2)*	21·8	3·65	21·7	3·59	21·8	3·70	0·635
12–13 years	20·9	3·66	20·9	3·58	20·8	3·73	0·773
14–15 years	21·8	3·51	21·7	3·53	21·9	3·50	0·448
16–17 years	22·5	3·74	22·4	3·60	22·6	3·87	0·752
Prevalence of overweight (%)†	17·5		19·9		15·5		0·052
12–13 years	18·8		15·3		21·8		0·176
14–15 years	19·6		24·9		15·1		0·003
16–17 years	12·4		14·4		10·6		0·324
Prevalence of obesity (%)†	10·4		12·7		8·5		0·020
12–13 years	14·8		21·0		9·5		0·008
14–15 years	9·8		11·3		8·5		0·252
16–17 years	7·7		7·9		7·5		0·893
WC (cm)*	69·7	8·40	72·6	8·14	67·3	7·84	0·000
12–13 years	67·6	8·69	69·9	8·23	65·6	8·61	0·000
14–15 years	69·9	7·97	72·7	7·60	67·6	7·51	0·000
16–17 years	71·4	8·58	74·8	8·40	68·3	7·53	0·000
WC > cut-off limits[9] (%)†	6·8		4·4		8·8		0·003
12–13 years	9·6		6·5		12·2		0·111
14–15 years	5·8		3·0		8·2		0·008
16–17 years	6·0		5·0		6·9		0·505
Hip circumference (cm)*	92·8	9·59	91·7	9·23	93·6	9·80	0·001
12–13 years	88·6	9·77	87·6	10·19	89·4	9·36	0·132
14–15 years	93·4	9·27	92·3	8·42	94·2	9·85	0·013
16–17 years	95·4	8·80	94·2	8·64	96·4	8·84	0·032
WHR*	0·76	0·097	0·79	0·047	0·72	0·116	0·000
12–13 years	0·77	0·080	0·80	0·045	0·74	0·091	0·000
14–15 years	0·75	0·117	0·79	0·046	0·72	0·146	0·000
16–17 years	0·75	0·064	0·79	0·050	0·71	0·047	0·000
WHR > cut-off limits[18] (%)†	0·3		0·2		0·5		0·403
12–13 years	0·7		0·0		1·4		0·194
14–15 years	0·2		0·0		0·3		0·360
16–17 years	0·3		0·7		0·0		0·283
Fat body mass (%)*	23·2	7·34	20·1	7·97	25·7	5·62	0·000
12–13 years	23·9	7·32	22·0	8·39	25·5	5·85	0·000
14–15 years	23·7	7·26	20·6	7·98	26·2	5·48	0·000
16–17 years	21·6	7·30	17·5	6·91	25·1	5·64	0·000

WC, waist circumference; WHR, waist:hip ratio.
* Significant differences between men and women by ANOVA.
† Significant differences between men and women by χ^2.

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Table 2. Sociodemographic and lifestyle characteristics of non-obese (BMI < P97) and obese (BMI ≥ P97) adolescents (OR and 95 % CI values)

	Boys								Girls							
	BMI < P97 (*n* 501)		BMI ≥ P97 (*n* 73)						BMI < P97 (*n* 601)		BMI ≥ P97 (*n* 56)					
	n	%	*n*	%	Crude OR	95 % CI†	Adjusted OR	95 % CI‡	*n*	%	*n*	%	Crude OR	95 % CI†	Adjusted OR	95 % CI‡
Age group (years)																
12–13	107	81·1	28	18·9	2·54	1·16, 5·57*	2·75	1·14, 6·64*	140	91·0	15	9·0	1·18	0·51, 2·72		
14–15	255	87·6	33	12·4	1·54	0·75, 3·19	1·52	0·69, 3·37	306	91·0	28	9·0	1·19	0·59, 2·42		
16–17	139	91·6	12	8·4	1·00	Ref.	1·00	Ref.	155	92·3	13	7·7	1·00	Ref.		
Place of birth																
Non-Spanish	76	91·7	8	8·3	0·58	0·22, 1·51			112	90·7	12	9·3	1·08	0·52, 2·24		
Others from Spain	33	87·1	6	12·9	0·94	0·32, 2·80			33	90·3	4	9·7	1·13	0·33, 3·89		
East of Spain	13	100·0	0	0·0	0·00	0·000			23	95·2	1	4·8	0·53	0·07, 4·04		
Balearic Islands	379	86·4	59	13·6	1·00	Ref.			433	91·3	39	8·7	1·00	Ref.		
Parental socioeconomic status																
Low	98	86·7	14	13·3	1·53	0·60, 3·89			149	89·2	17	10·8	3·24	1·04, 10·05*		
Medium	290	86·3	46	13·7	1·59	0·74, 3·44			319	89·5	33	10·5	3·14	1·08, 9·11*		
High	113	90·9	13	9·1	1·00	Ref.			133	96·4	6	3·6	1·00	Ref.		
Parental educational level																
Low	162	81·6	33	18·4	2·99	1·46, 6·12**	3·47	1·58, 7·62**	212	86·1	31	13·9	3·75	1·60, 8·79**	3·29	1·38, 7·89**
Medium	148	86·2	24	13·8	2·12	0·99, 4·53	2·35	1·04, 5·34*	199	92·5	15	7·5	1·87	0·74, 4·76*	1·89	0·73, 4·94*
High	191	93·0	16	7·0	1·00	Ref.	1·00	Ref.	190	95·9	10	4·1	1·00	Ref.	1·00	Ref.
Hours of sleep (h/d)																
< 7	34	77·8	6	22·2	2·03	0·64, 6·37	3·42	0·88, 13·26	54	90·9	4	9·1	1·06	0·36, 3·09		
≥ 7	467	87·6	67	12·4	1·00	Ref.	1·00	Ref.	547	91·4	52	8·6	1·00	Ref.		
Number of meals																
1–3	122	79·2	31	20·8	4·87	2·20, 10·82***	4·99	2·1, 11·54***	257	88·3	34	11·7	1·78	0·85, 3·77*	2·20	0·99, 4·89*
4	175	85·6	31	14·4	3·11	1·41, 6·88**	2·60	1·13, 5·98*	192	94·5	11	5·5	0·78	0·32, 1·93	0·83	0·32, 2·16
≥ 5	204	94·9	11	5·1	1·00	Ref.	1·00	Ref.	152	93·1	11	6·9	1·00	Ref.	1·00	Ref.
Breakfast habit																
Yes	385	88·5	52	11·5	0·50	0·22, 1·17			377	93·6	26	6·4	0·56	0·26, 1·20		
Occasionally	75	85·1	12	14·9	0·68	0·25, 1·85			122	87·3	17	12·7	1·19	0·53, 2·69		
No	41	79·5	9	20·5	1·00	Ref.			102	89·1	13	10·9	1·00	Ref.		
Sweets or salty snacks																
Yes	99	90·7	9	9·3	0·77	0·32, 1·83			144	93·2	11	6·8	0·59	0·26, 1·33		
Occasionally	161	84·8	29	15·2	1·35	0·74, 2·46			181	92·2	17	7·8	0·68	0·36, 1·29		
No	241	88·2	35	11·8	1·00	Ref.			276	89·0	28	11·0	1·00	Ref.		
Attention to mass media (TV + radio)																
Yes	320	86·0	52	14·0	1·52	0·81, 2·84			427	90·7	44	9·3	2·06	0·91, 4·68		
No	131	90·3	14	9·7	1·00	Ref.			140	95·2	7	4·8	1·00	Ref.		
Alcohol consumption																
Yes	194	90·8	21	9·2	1·09	0·61, 1·97			365	90·9	24	9·1	0·55	0·30, 1·01		
No	307	84·4	52	15·6	1·00	Ref.			236	91·6	32	8·4	1·00	Ref.		
Current smoking habit																
Yes	37	91·2	3	8·8	0·66	0·19, 2·28			35	85·7	5	14·3	2·51	0·88, 7·13		
Occasionally	290	86·1	42	13·9	1·10	0·62, 1·93			359	88·8	33	11·2	1·89	1·02, 3·51*		
No	174	87·2	28	12·8	1·00	Ref.			207	93·8	18	6·2	1·00	Ref.		
Physical activity level																
No active	161	83·7	33	16·3	1·57	0·91, 2·73			346	89·7	38	10·3	1·68	0·91, 3·12	1·87	0·96, 3·64
Active	340	89·0	40	11·0	1·00	Ref.			255	93·6	18	6·4	1·00	Ref.	1·00	Ref.

Ref., reference.
† Univariate analysis (logistic regression analysis considering the effect of one explanatory variable): significant differences (* $P < 0·05$, ** $P < 0·01$, *** $P < 0·001$).
‡ Multivariate analysis (multiple logistic regression analysis considering the simultaneous effect of all explanatory variables): significant differences (* $P < 0·05$, ** $P < 0·01$, *** $P < 0·001$).

statistical significance; an inverse association between parental education level and number of daily meals, and BMI in boys and girls was also found. None of the other lifestyle variables considered in the present study (place of birth, breakfast habit, sweets or salty snacks consumption and alcohol consumption) was significantly associated with obesity in any sex.

A positive correlation between sugar-sweetened beverages consumption and watching TV was found (r 0·123, $P<0·001$). However, no significant association between sweetened-beverages consumption and body weight status was found.

Although no significant difference in sedentary behaviour was found between obese and non-obese adolescents, high body fat (≥P85) was associated with a less time spent in vigorous-intensity physical activities in both boys (r −0·174, $P<0·001$) and girls (r −0·102, $P<0·05$).

Table 3 shows dietary characteristics of obese and non-obese boys and girls excluding misreporters. No statistical significant difference in prevalence of misreporters was observed between obese and non-obese subjects (data not shown). Obese boys and girls reported a significant lower intake of energy than non-obese adolescents. There were no differences in the dietary origin of the energy between obese and non-obese adolescents.

Discussion

The present results reveal the magnitude of overweight and obesity among 12–17-year-old adolescents in Balearic Islands. The observed percentages of prevalence of overweight (boys 19·9 %; girls 15·5 %) and obesity (boys 12·7 %; girls 8·5 %) among adolescents in Balearic Islands are higher in boys than girls as in most European countries[21]. In comparison with other data, despite differences in ages studied and the percentile considered as indicator of obesity in adolescents (we considered the 97th percentile), prevalence of overweight and obesity is higher than in Portugal (overweight 16·6 % boys and 12·9 % girls; obese 3·6 % boys and 2·7 % girls), Belgium (overweight 8·6 % boys and 7·4 % girls; obese 1·8 % boys and 1·5 % girls) and Ireland (overweight 17 % boys – exception girls, which has a high prevalence, 21 %; – obese 6 % boys and 7 % girls), whereas the prevalence of obesity is lower and the prevalence of overweight is higher than in the enKid Study of the Spanish population (obese 15·8 % boys and 9·1 % girls; overweight 10·4 % boys and 8·0 % girls), Canary Islands (obese 12·0 % boys and 17·6 % girls; overweight 10·8 % boys and 11·9 % girls), Germany (obese 13·9 % boys and 11·7 % girls; overweight 12·5 % boys and 10·2 % girls) and the United States (obese 16·7 % boys and 15·4 % girls; overweight 14·5 % boys and 15·1 % girls)[22–26].

The association between sociodemographic and lifestyle factors and BMI in adolescents of the Balearic Islands showed that parental education level is one of the strength factors associated with prevalence of obesity in boys and girls, which agrees data reported by other authors[27].

Multiple logistic regression analysis also revealed an inverse association between age and obesity in boys. Previous studies pointed out that the trend in the prevalence of overweight (including obesity) decreases with age in adolescents[28].

Previous works reported that girls paid more attention to foods than boys as a way to influence health and to meet nutritional recommendations and then to prevent or to reverse the obese state[29]. We have observed that both obese boys and girls reduced the number of meals per day, skipped the breakfast and avoided sweets and salty snacks consumption, which is more evident in girls, as a method to counteract the obesity.

We observed an inverse association between obesity and the number of daily meals, which is observed in boys and

Table 3. Energy and nutrient intakes and selected food group consumption in non-obese (BMI < P97) and obese (BMI ≥ P97) adolescents

(Mean values and standard deviations)

	BMI < P97		BMI ≥ P97			
	Mean	SD	Mean	SD	Crude analysis†	Adjusted analysis‡
Boys§						
EI (MJ)	9·7	3·44	8·0	3·25	*	**
EI (kJ/kg per d)	164·9	61·40	98·2	39·84	**	**
EI (kJ/kg lean body mass per d)	200·9	72·26	143·6	57·03	**	**
Energy from CHO (%)	45·5	7·98	45·6	10·10	NS	NS
Energy from total fat (%)	37·5	7·01	37·5	9·41	NS	NS
Energy from SFA (%)	13·4	3·86	12·8	4·94	NS	NS
Energy from proteins (%)	16·9	4·40	16·8	3·88	NS	NS
Girls‖						
EI (MJ)	7·7	2·63	5·7	2·47	**	**
EI (kJ/kg per d)	144·5	56·9	71·9	30·76	**	**
EI (kJ/kg lean body mass per d)	192·0	71·66	114·5	48·15	**	**
Energy from CHO (%)	44·2	8·96	44·8	11·90	NS	NS
Energy from total fat (%)	38·6	7·98	36·0	9·96	NS	NS
Energy from SFA (%)	13·3	4·04	11·9	4·72	NS	NS
Energy from proteins (%)	17·2	4·87	19·0	6·14	NS	NS

EI, energy intake; CHO, carbohydrates.
† Crude analysis: significant differences (* $P<0·01$, ** $P<0·001$) between group means by ANOVA.
‡ Adjusted analysis: significant differences (** $P<0·001$) after controlling for age by multiple logistic regression.
§ Boys: n 306 and 36 for BMI < P97 and BMI ≥ P97, respectively.
‖ Girls: n 351 and 34 for BMI < P97 and BMI ≥ P97, respectively.

girls. This inverse association between obesity and meal frequency is in agreement with previous studies developed in children[30,31].

We detected a greater risk to be obese in adolescents that do not have breakfast, despite the lack of statistical significance. The omission or consumption of an inadequate breakfast is usual in adolescents[32], although its consumption has been identified as an important factor in the nutritional well being of children and it is rarely compensated for in other meals of the day[27]. Adolescents must be conscience that to skip meals is not an appropriate method to reduce the risk of obesity[31].

We also found that adolescents showed low risk of obesity when they usually consume sweets and salty snacks, which may sound controversial. It may be possible that they underreported their sweets and salty snacks consumption. However, both obese boys and girls consume proportionally less sweets and salty snacks than their lean pairs; it may be a method to self-control their body weight.

A positive association between BMI and distraction during mealtime has been detected, and many adolescents are distracting especially watching the TV (68·4 % of boys; 72·1 % of girls) and listen to the radio (13·0 % of boys; 14·6 % of girls), compared with those that declared to get up from the table (14·0 % of boys; 18·2 % of girls) and to speak during mealtime (57·4 % of boys; 67·5 % of girls). Different studies have detected a positive association between BMI and body fatness and TV among children and adults[33,34]. Despite TV viewing being linked to lower physical activity, Jackson *et al.*[34] suggested that the relation between TV viewing and fatness is more likely to be due to an effect on food intake. TV viewing during mealtime is inversely associated with consumption of products not advertised, such as fruits and vegetables[1]; leads to more eating and encourages the consumption of 'socially prestigious', 'healthy' and/or 'tasty' foods and drinks[27]; and a large proportion of televised food advertisements are for highly processed 'junk foods'[27]. In agreement with a previous study[35], sugar-sweetened beverages' consumption was positively correlated to watching TV, but no significant association between sweetened-beverages' consumption and body weight status was found. Controversial results about sugar-sweetened beverage consumption and body weight can be found in the literature[35,36], which may be explained in part by differences in the design of the study, in definitions of sugar-sweetened beverages and methodological bias in self-reported data. Overall, adolescents must be conscience that watching the TV during mealtime is not a good practice to have a healthy diet, and health promotion plans must be devoted of it.

Short sleep ($\leq$7 h/d) is associated with obesity compared with longer sleep in boys, whereas no association has been found in girls. These results agree previous studies that suggested a negative association between usual sleep duration and obesity or body weight in children and adults[37,38]. Other studies suggest that boys are more susceptible to sleep less than girls[39]. However, recent reviews of the epidemiological evidence have now pointed out that it is still precipitous to suggest that sleep is a cause or solution to the obesity epidemic and further studies are needed[37,38].

Adolescence is a time of rapid physiological, psychological and social development, and also a key period for the adoption of tobacco use. Is there any relationship between obesity and smoking habit in adolescents? Smoker girls showed higher risk of obesity than non-smokers, whereas usually smoking habit was associated with a low risk of obesity in boys. Previous studies showed similar BMI, energetic intake and fat intake among smokers and non-smokers, in spite of 40 % adolescents believed that smoking will decrease or control their weight[40]. This belief may be supported by the fact that smoke decreases the taste threshold and also girls exhibit greater taste sensitivity than boys, and these differences are of hormonal nature[41]. Consequently, girls apply this method to 'reduce' their weight because girls are usually more worried about their image than boys; however, it cannot be discarded that to smoke may also be a facilitating factor of social relationships[42]. Adolescents need to be more aware about this unhealthy behaviour, so education programmes related to healthy behaviours are needed in adolescence to prevent future health problems.

We also observed that EI is lower in non-obese than in obese boys and girls, with no differences in the dietary origin of the energy. This paradoxical effect could be attributed to the validity of the instruments to measure food consumption in the population. It is also possible that obese adolescents overestimated the consumption of healthy food items and underestimated the consumption of unhealthy foods, because it has been well documented that people with greater relative weight usually underreported their food intake[5].

The 24 h recalls provide information on food intake, and because the data collection occurs after consumption, this method does not affect an individual's food choices on a given day[43]. At least, two non-consecutive administrations are necessary to assess usual intakes, to reduce dependency on intake from the previous day and by household food availability[43]. Accordingly, we applied two 24 h non-consecutive recalls in the present study.

Although 24 h recalls collect data soon after intake, recalls have also limitations related to memory and bias[43]. Difficulties assessing portion sizes could also contribute to underestimation of EI[44]. Many adolescents have found it difficult to estimate their consumption of some foods, and the consequence of difficulties in assessing high energy-dense foods may be that consumed amounts are underestimated, which, in turn, may have a great effect on the validity of the reported EI[44]. Underreporting and overreporting are significant contributors to the systematic bias of self-reported dietary assessments, increasing or decreasing estimates of the incidence of inadequate intake and distorting the relationships between nutrient intake and health. Therefore, there are real shortcomings in dietary studies.

To solve these shortcomings, it has been pointed out[12] that dietary studies should include an internal validation procedure. Biomarkers of EI have been suggested to play a useful role in dietary assessment, especially for components of foods that are highly variable within different samples of the same food. However, biomarkers, even when available, also have many limitations[45]. Advantages and limitations of each must be carefully considered in any specific application, but the mainstay of nutritional epidemiology will remain assessments of dietary intake.

Since 1995, the Goldberg *et al.* cut-off[13] has been used to identify EI misreporters. However, the Goldberg cut-off has been usually misinterpreted. Black[12] restates the principles underlying the Goldberg cut-off for identifying underreporters of EI. According to Black contributions[12], the Goldberg cut-off can be used to determine the degree of overall bias to reported EI in a dietary assessment. Comparison should be made with a PAL value appropriate to the study population based on information about physical activity or lifestyle. A short questionnaire on home, leisure and occupational activity such that subjects may be assigned to low, medium or high PAL for calculating the Goldberg cut-off should be included as routine. One comparison of a simple questionnaire and a detailed activity diary has suggested that the former might be adequate for large-scale studies[46]. Therefore, we used the Black's modification of Goldberg cut-off to solve the EI misreporting, in spite of that we are conscious that this is just an approximation to the misreporting problem, and that the solution of EI misreporting still needs further research. A late validation study[44] of dietary assessment methods using double-labelled water in children and adolescents founded, however, similar percentages of EI misreporters to ours.

Physical activity is a complex multidimensional exposure, which is difficult to measure by self-reported questionnaires in epidemiological studies[47]. Self-report of physical activity can lead to overreport it due to a social desirability bias, and therefore the number of inactive individuals may be greater than that reported[48,49], especially among children and adolescents, and also among obese[48]. Questionnaires have inherent limitations, mainly because they are subjective in nature. Limitations in the validity of physical activity questionnaires are considered the main reasons for inaccuracies in epidemiological studies.

An extensive range of instruments for measuring physical activity has been reported in the literature, but critical elements in the utility of an instrument to measure physical activity are that it will be relatively inexpensive, cause minimal inconvenience to the participant and be able to be administered with relative ease[50].

Furthermore, Black's modification of Goldberg cut-off and many of the methodological challenges that face nutritional epidemiology are mirrored in the assessment of physical activity. It is well established that a sedentary lifestyle with a low level of energy expended on physical activities is a risk factor of weight gain[5]. We found that the risk of obesity is higher in physically inactive adolescents than in active adolescents, despite the lack of statistical significance. Balearic Islands' obese and non-obese adolescents showed no different sedentary behaviour, but high body fat was associated with a less time devoted to vigorous-intensity physical activities in both boys and girls. One of the worldwide suggested factors for obesity prevention is to encourage the physical activity practice, which decreases annually about 2·7 % among boys and 7·4 % among girls between the ages of 10 and 17[29].

However, the capacity to convert these physiological data to estimates of energy expenditure at low and high intensities of effort requires clarification[51]. The intensity of the physical activity needs to be assessed relative to each individual's physiologic capacity, and referenced to resting metabolism or maximal aerobic capacity. There are still shortcomings in the employment of instruments to measure physical activity. So, questionnaires on detailed activity diary might be adequate for large-scale studies[46].

Conclusions

To sum up, the prevalence of overweight and obesity in the Balearic Islands' adolescents should take into consideration. The main risk factors associated with prevalence of obesity in adolescents are the age, the parental education level, to skip meals, the distraction during mealtime, a short sleep and the current smoking habit. A programme of action including school healthy nutritional education and promotion programmes targeted at parents and adolescents is needed. These programmes may be mainly focused to increase educational level, to make the adolescents to be aware of to skip meals and to smoke are not useful methods to reduce the risk of obesity, but to do not eat while watching TV, to sleep 8–10 h/d and to be physically active.

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Manuscrit II

Metabolic syndrome in adolescents in the Balearic Islands, a Mediterranean region.

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Metabolic syndrome in adolescents in the Balearic Islands, a Mediterranean region

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KEYWORDS
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Mediterranean diet

Abstract *Background and aims:* To determine the prevalence of metabolic syndrome (MetS) and its components in adolescents in the Balearic Islands, in the western Mediterranean Sea.
Methods and results: A cross-sectional nutritional survey was carried out in the Balearic Islands (2007—2008). A random sample ($n = 362$, 143 boys and 219 girls) of the adolescent population (12—17 years) was interviewed, anthropometrically measured, and provided a fasting blood sample. The MetS prevalence was determined by the ATP III criteria adapted for youths. Adherence to the Mediterranean diet (MD) was defined according to a score constructed considering the consumption of MD components: high monounsaturated fatty acids (MUFA)/saturated fatty acids (SFA) ratio, moderate ethanol consumption, high legume, cereals and roots, fruit, vegetables, and fish consumption, and low meat and milk consumption.

The overall MetS prevalence was 5.8% (boys 10.5%, girls 2.7%). MetS criteria were met by 10.0% of overweight, 45.5% of obese and in 1.8% of normal weight adolescents. Half of the adolescents (49.7%) had at least one MetS component. None of the adolescents had all five risk factors. High triglyceride level (90.5%), hypertension (85.7%), low HDL cholesterol level (78.9%) and central obesity (71.4%) were common among adolescents with MetS whereas hyperglycaemia (0.6%) was infrequent. Higher adherence to MD was associated with significantly lower odds ratio of having MetS, but half of the adolescents showed high adherence to MD.
Conclusion: MetS prevalence was significant among adolescents in the Balearic Islands, especially among obese boys. A high adherence to MD in adolescents was associated with a low prevalence of the MetS criteria.

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Introduction

The prevalence of metabolic syndrome (MetS) in adolescents has been estimated at 4% overall. Although this prevalence is low in children of normal weight, it is high (30—50%) among obese children and adolescents [1], and a high percentage of adolescents have at least one MetS risk factor [2,3].

It is believed that MetS could be triggered by both genetic and environmental factors [1]. Ethnicity [2], parental educational level and socioeconomic status [3], excess calorie intake, and low levels of physical activity [1] have been associated with the prevalence of MetS in youth.

MetS and its individual components are detectable during childhood, and these commonly persist throughout adolescence and adulthood [4,5]. Therefore, identifying MetS during childhood will be essential to curb the development and progression of cardiovascular and metabolic diseases during adulthood [5].

However, few data regarding MetS prevalence are available in adolescents from Mediterranean areas where obesity is becoming a social emergency even in paediatric populations [6]. Higher adherence to the Mediterranean diet (MD) has been associated with low prevalence of MetS [7], but it is being lost among the younger generations in the Mediterranean area [8,9].

The aim of this study was to assess the prevalence of MetS and its components in adolescents in the Balearic Islands, in the western Mediterranean Sea.

Methods

Study design

The study is a population-based cross-sectional nutritional survey carried out in the Balearic Islands (2007—2008).

Selection of participants, recruitment and approval

This study is part of a larger research project in which the target population consisted of all inhabitants aged 12—17 years living in the Balearic Islands. The sample population was derived from residents aged 12—17 years registered in the Balearic Islands' scholar census. The theoretical sample size was set at 1500 individuals in order to provide a specific relative precision of 5% (type I error = 0.05; type II error = 0.10), taking into account an anticipated 70% participation rate. The sampling technique included stratification according to municipality size, age, 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. The final sample size was 1231 individuals (82% participation). Participants were invited to provide blood samples in order to determine biochemical parameters. Three hundred and sixty-two subjects participated in the biochemical phase (30% participation). The reasons not to participate were (a) the subject declined or (b) the parents did not authorise the interview or blood sample provision. There were no statistical differences between the characteristics (age, sex proportion, and anthropometry) of the individuals in the final sample and the blood sample providers. The interviews, anthropometric and blood pressure (BP) measurements were performed at schools by two well-trained observers to avoid the inter-observer coefficients of variation. Inter- and intra-observer coefficients of variation were less than 5%. The blood samples were also taken at the schools.

Anthropometric measurements

Height was determined to the nearest millimetre using a mobile anthropometer (Kawe 44444, France), with the subject's head in the Frankfurt plane. Body weight was determined to the nearest 100 g using a digital scale (Tefal, sc9210, France). The subjects were weighed in bare feet and light underwear, which was accounted for by subtracting 300 g from the measured weight. Triceps skinfold (TSF) and subscapular skinfold thickness (SCSF) were measured using a Holtain skinfold calliper (Tanner/Whitehouse, Crymych, UK), and the mean of three measurements (right arm) was used to calculate body fat (BF) as described previously [10].

Waist circumference (WC) and hip circumference (HC) were measured using a non-stretchable measuring tape (Kawe 43972, France). The subjects were asked to stand erect on a flat surface in a relaxed position with both feet together. WC was measured as the smallest horizontal girth between the costal margins and the iliac crests at minimal respiration. Measurements were made to the nearest 0.1 cm. HC was taken as the greatest circumference at the level of the greater trochanter (the widest portion of the hip) on both sides. Measurements were made to the nearest 0.1 cm. For both WC and HC, two measurements were made, and the mean of the two readings was taken as the final value. The waist-to-hip ratio (WHR) was also calculated.

Automated (Omron, M4-I, Healthcare Co. Ltd., Japan) BP measurements to the nearest 1 mmHg were taken from seated participants with the right arm resting and palm facing upward. Two readings were taken 5 min apart, and the mean of the two readings was taken. If the difference between the first and the second reading was $\geq$10 mmHg for systolic pressure (SBP) and/or $\geq$6 mmHg for diastolic pressure (DBP), then a third measurement was made, and the mean of all three measurements was taken. According to the WHO classification, the prevalence of overweight (BMI $\geq$I p85 $<$ p97) and obesity (BMII $\geq$I p97) were calculated taking age and gender into consideration [11].

General questionnaire

Information was collected about age, parental educational level (grouped according to years and type of education: low, $<$6 years of education; medium, 6—12 years; high, $\geq$12 years), parental socioeconomic level (based on the occupation of parents and classified as low, medium and high, according to the Spanish Society of Epidemiology methodology [12]), smoking habit (no; yes; occasionally, $<$1 cigarette/day), and alcohol consumption (no; frequently; occasionally, less than 1 drink/week).

Physical activity (PA) was evaluated according to guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ) [13] in the short form. The specific types of activity assessed were walking, moderate-intensity activities (i.e. PA at school), vigorous-intensity activities (i.e. sport practice) and sitting time (used as an indicator variable of time spent in sedentary activity). Information on hours per day of television viewing, computer use, video games, other leisure time physical activity practice and typical sleep duration to the nearest 10 min was also included. PA assessed by the IPAQ was correlated with Physical Activity Level (PAL) according to the estimation of the individualised activity coefficient. Each subject was classified taking into account their PAL value [14] as: sedentary (PAL 1.0 $<$ 1.4), low active (PAL 1.4 $<$ 1.6), active (PAL 1.6 $<$ 1.9), and very active (PAL 1.9).

Determination of glycaemia, triglycerides, total cholesterol, and HDL-cholesterol

Venous blood samples were obtained from the antecubital vein in suitable vacutainers at 08:00 h of the interview day after 12-h overnight fasting conditions. Serum glycaemia, triglycerides (TG) and total cholesterol, and HDL-cholesterol were determined by colorimetric methods using the DAX-72 autoanalyser (Technicon, Bayer) [15,16].

Metabolic syndrome definition

The MetS definition used in this study was that for adolescents proposed by de Ferranti et al. [17], with criteria based closely on the Adult Treatment Panel III (ATP III) [18]. Participants were defined as having MetS if they met or exceeded the criteria for three or more of the following five variables: triglyceridaemia $\geq$1.1 mmol/L; HDL-cholesterol $<$1.3 mmol/L (boys aged 15—17 years $<$1.17 mmol/L); fasting blood glycaemia $\geq$6.1 mmol/L; waist circumference (cm) $>$75th percentile for age and sex [19]; systolic or diastolic blood pressure (mmHg) $>$90th percentile for age, sex and height [20].

Dietary questionnaire

Two non-consecutive 24-h diet recalls and a validated [21] semi-quantitative food-frequency questionnaire (FFQ, 145 food items) were obtained from the participants. Two well-trained dieticians administered the recalls and verified and quantified the food records. To estimate volumes and portion sizes, the household measures found in the subjects' own homes were used. Conversion of food into nutrients was made using a self-made computerised program based on Spanish [22] and European [23] Food Composition Tables and complemented with Balearic Islands' food composition data [24].

Mediterranean dietary pattern

The Mediterranean dietary pattern has been defined according to a previously defined score indicating the degree of adherence to the traditional MD [8,25] which was calculated from the FFQ food items.

Statistics

Analyses were performed with SPSS 16.0. All tests were stratified by sex. Significant differences in prevalence were calculated by means of χ^2. Differences between group means were tested using ANOVA. Quartiles of the adherence to the MD were built. A multiple logistic regression model was used to evaluate the odds ratio for each of the three upper quartiles of adherence to the MD (compared with the lowest quartile) and the prevalence of MetS or its components. The multivariate logistic regression was adjusted for sex, age, parental educational level, parental socioeconomic status and physical activity level. Multiple logistic regression was used to assess the association between MD quartiles (dependent variables) and each of the MetS components (dependent variables). Multiple logistic regression models with polynomial contrast were used to generate *P* for trend. The analyses were conducted first for the whole sample and then separately for boys and girls.

Ethics

All participants and parents were informed of the purpose and methods of this study and provided written informed consent before enrolment. The study protocol was in accordance with the Declaration of Helsinki and was approved by the Balearic Islands Ethics Committee.

Results

Table 1 shows the characteristics of the participants. The adolescents studied were homogenous in terms of age, BMI groups, parental educational level and socioeconomic status, PAL, current smoking habit, and alcohol consumption. There were significant differences in height, weight, WC, HC, WHR, total body fat, SBP, DBP, and fasting glycaemia and high-density lipoprotein cholesterol (HDL-c) levels between boys and girls, but no differences in BMI and TG levels were found. Boys were more active than girls. The mean adherence to the MD was 51.7% (SD 8.7) and the median adherence was 50.8%. Half of Balearic Islands' adolescents, both boys and girls, were above the median value.

Table 2 shows MetS components among adolescents (high fasting glycaemia, high triglyceridaemia, low HDL-cholesterol level, abdominal obesity and hypertension) according to gender, BMI status, and adherence to the MD. The overall prevalence of MetS was 5.8%. This prevalence was higher in boys (10.5%) than in girls (2.7%). The criteria for MetS were met by 45.5% of obese (63.6% boys; 27.3% girls), by 10.0% of overweight adolescents (14.8% boys; 6.1% girls), and by 1.8% of normal weight adolescents (3.8% boys; 0.6% girls).

Half of the adolescents (49.7%) had at least one component of MetS: 43.9% had 1—2 risk factors, 4.7% had 3 risk factors and 1.1% had 4 risk factors. No adolescent had all five risk factors for MetS (data not shown). Hypertension was the most commonly observed component of MetS (27.1%), while high fasting glycaemia was the least common (0.6%). The prevalences of low HDL-cholesterol level,

Table 1 Characteristics of the participants.

	Boys (n = 143)	Girls (n = 219)	Total (n = 362)
Age (years)	14.6 ± 1.50	14.8 ± 1.3	114.8 ± 1.37
Height (cm)	170.5 ± 9.24	161.6 ± 6.23	165.1 ± 8.73***
Weight (kg)	62.6 ± 12.02	57.3 ± 9.63	59.4 ± 10.92***
BMI (kg/m^2)	21.4 ± 3.03	21.9 ± 3.26	21.7 ± 3.18
BMI status (%)			
Normal weight	73.4	79.9	77.3
Overweight	18.9	15.1	16.6
Obesity	7.7	5.0	6.1
WC (cm)	72.1 ± 7.41	67.3 ± 7.33	69.2 ± 7.72***
HC (cm)	91.4 ± 8.65	94.7 ± 8.00	93.4 ± 8.40***
WHR	0.79 ± 0.05	0.71 ± 0.06	0.74 ± 0.07***
Total body fat (%)	19.9 ± 6.67	25.6 ± 5.03	23.4 ± 6.38***
Parental educational level (%)			
Low	26.3	35.7	32.0
Medium	25.5	32.9	30.0
High	48.2	31.5	38.0
Parental socioeconomic status (%)			
Low	17.4	26.7	23.1
Medium	55.3	48.6	51.2
High	27.3	24.8	25.7
Physical activity level (%)†			
Sedentary	0.7	3.7	2.5
Low active	25.2	46.1	37.8
Active	64.3	42.0	50.8
Very active	9.8	8.2	8.8
Current smoking habit (%)			
Yes	4.4	4.8	4.6
Occasional	16.8	20.7	19.1
Never	78.8	74.5	76.2
Alcohol consumption (%)			
Yes	39.9	48.4	45.0
No	60.1	51.6	55.0
Fasting glycaemia level (mM)	4.6 ± 0.48	4.4 ± 0.47	4.5 ± 0.49**
TG (mM)	0.86 ± 0.37	0.81 ± 0.29	0.83 ± 0.33
HDL-c (mM)	1.4 ± 0.30	1.7 ± 0.34	1.6 ± 0.34***
SBP (mmHg)	122.6 ± 15.82	113.9 ± 12.90	117.29 ± 14.74***
DBP (mmHg)	66.7 ± 10.26	69.3 ± 8.45	68.3 ± 9.28*
Adherence to MD (%)			
Above median value (≥50%)	53.5	59.1	56.8
Q3	25.9	22.8	24.0
Q4	27.3	28.8	28.2
Under median value (<50%)	46.5	40.9	43.2
Q1	23.1	23.7	23.5
Q2	23.8	24.7	24.3

Abbreviations: BMI, body mass index; WC, waist circumference; HC, hip circumference; WHR, waist-to-hip ratio; TG, triglyceride level; HDL-c, high-density lipoprotein cholesterol level; SBP, systolic blood pressure; DBP, diastolic blood pressure; MD, Mediterranean diet; Q, quartiles.
Significant differences between men and women by ANOVA: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. †Significant differences between men and women by χ^2 ($p < 0.001$).

hypertriglyceridaemia, and abdominal obesity were similar among adolescents (16.5%, 14.9% and 15.5%, respectively). The highest values of MetS components were observed among obese adolescents. The prevalence of MetS components was higher among adolescents with low adherence to the MD, despite the lack of statistical significance.

The percentage of participants with cardiovascular disease risk factor values above the cut-off point for defining MetS is shown in Table 3. High triglyceridaemia (90.5%), high blood pressure (85.7%), low HDL-cholesterol level (78.9%) and central obesity (71.4%) were commonly associated with MetS criteria while hyperglycaemia was infrequent in adolescents with MetS. High systolic blood pressure was more common than high diastolic blood pressure. A higher percentage of subjects with MetS was observed among adolescents with low adherence to the MD.

Table 2 Prevalence of metabolic syndrome components among adolescents.

	No. of subjects	High fasting glycaemia	High TG	Low HDL-c	Abdominal obesity (WC)	Hypertension	Metabolic syndrome
Total	362	0.6	14.9	16.5	15.5	27.1	5.8
Sex							
Boys	143	0.7	18.2	25.4***	12.6	31.5	10.5**
Girls	219	0.5	12.8	10.4	17.4	24.2	2.7
BMI status and sex							
Normal weight	280	0.4	11.8	13.9	2.5	22.1	1.8
Boys	105	0.0	11.4	21.6**	1.9	21.0	3.8**
Girls	175	0.6	12.0	9.1	2.9	22.9	0.6
Overweight	60	1.7	20.0	21.8	45.0	35.0	10.0
Boys	27	3.7	29.6	26.9	18.5***	55.6**	14.8
Girls	33	0.0	12.1	17.2	66.7	18.2	6.1
Obesity	22	0.0	40.9	36.8	100.0	68.2	45.5
Boys	11	0.0	54.5	60.0**	100.0	72.7	63.6
Girls	11	0.0	27.3	11.1	100.0	63.6	27.3
Adherence to MD (%)							
Above median value (≥50%)	206	0.4	15.1	17.4	17.5	30.4	5.3
Q3	102	0.0	16.3	11.8	11.6	26.7	4.7
Q4	104	1.0	15.8	16.3	17.8	27.7	5.9
Under median value (<50%)	156	0.8	15.4	18.6	18.5	31.3	6.7
Q1	80	1.2	11.9	23.2	14.3	29.8	6.0
Q2	76	0.0	14.9	15.2	18.4	25.3	6.9

Abbreviations: TG, triglyceride level; HDL-c, high-density lipoprotein cholesterol level; WC, waist circumference; MD, Mediterranean diet; Q, quartiles.
Statistically significant differences between men and women: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

The association of anthropometric variables (weight, height, BMI, fat, fat-free mass (FFM), WC, HC, WHR, TSF and SCSF) with MetS was also evaluated (Table 4). Individuals having MetS showed greater and more statistically significant values for all anthropometric variables evaluated with the exception of height after adjustment for sex, age, parental educational level, parental socioeconomic status and PAL (data not shown).

Table 5 shows the relationship between MetS criteria and adherence to the MD. A higher adherence to the MD (quartile 4) was associated with a lower prevalence of the high triglyceride and low HDL-cholesterol criteria in relation to the first quartile. No association between anthropometric variables and adherence to the MD was observed (data not shown).

Discussion

The importance of identifying children and adolescents who are at risk of developing MetS cannot be underestimated. Hence, the prevalence of MetS has been studied in several countries and ethnicities, but there are scarce data from Mediterranean adolescents which do, however, show increased obesity percentages [6]. Therefore, the aim of this study was to contribute to the knowledge on MetS prevalence in Mediterranean adolescents. This is the first time that MetS has been assessed in the adolescent population of the Balearic Islands, a Mediterranean region.

The MetS prevalence in Balearic Islands' adolescents (12–19 years) was 5.8% (10.5% boys and 2.7% girls) according to the ATP III criteria adapted by Ferranti et al. [17]. In spite of differences in MetS definition and studied ages, which hampered direct comparison across studies, this MetS prevalence is quite similar to previously reported data for adolescents: The US NHANES studies reported a MetS prevalence of 4.2% (6.1% boys, 2.1% girls) in 1988–1994, 6.4% (6.5% boys, 3.8% girls) in 1999–2000, 4.5% (7.4% boys, 2.4% girls) in 2001–2002, and 3.8% (7.3% boys, 3.0% girls) in 2003–2004 [26–28]. However, these rates may underestimate the current extent of the problem, because both the magnitude and prevalence of childhood obesity have been increasing in the past decade in Western societies. In Andalusia, a Spanish region, a MetS prevalence of 6.2% among 12- to 17-year-old adolescents has recently been reported [29].

Our findings indicate that MetS is far more common among our obese adolescents (45.5%) compared with overweight (10.0%) and normal-weight adolescents (1.8%). Despite differences in the percentile considered as an indicator of obesity (we considered P97, and previous studies just considered P95), the MetS prevalence in Balearic Islands' obese adolescents was higher than those (12–44%) reported worldwide [27,30,31], but also higher than Spanish (Andalusian) adolescents (26.7%) [29], whereas the MetS prevalence in overweight adolescents was in accordance with all previous studies (6–14%).

Table 3 Percentage of participants with cardiovascular disease risk factor values above the cut-off point for defining metabolic syndrome.

	Boys		Girls		Total	
	Without MetS (n = 128)	With MetS (n = 15)	Without MetS (n = 213)	With MetS (n = 6)	Without MetS (n = 341)	With MetS (n = 21)
Cardiovascular disease risk factors						
High fasting glycaemia	0.8	0.0	0.5	0.0	0.6	0.0
High TG	10.2	86.7	10.3	100.0	10.3	90.5
Low HDL-c	17.9	86.7	9.6	50.0	12.8*	78.9
Abdominal obesity (WC)	7.0	60.0	15.0	100.0	12.0*	71.4
Hypertension	24.2	93.3	23.0	66.7	23.5	85.7
Elevated SBP	21.1	93.3	17.8	50.0	19.1	81.0
Elevated DBP	3.9	13.3	8.9	50.0	7.0	23.8
Adherence to MD (%)						
Above median value (≥50%)	88.7	11.3	98.6*	1.4*	94.7*	5.3*
Under median value (<50%)	88.1	11.9	96.5*	3.5*	93.3*	6.7*

Abbreviations: MetS, metabolic syndrome; TG, triglyceride; HDL-c, high-density lipoprotein cholesterol; WC, waist circumference; SBP, systolic blood pressure; DBP, diastolic blood pressure; MD, Mediterranean diet.
*Statistically significant differences between men and women by χ^2 ($p < 0.05$).

Comparative findings about the mean values of anthropometric variables of groups with and without MetS can be explained by the recognised association between excess weight and body fat, and metabolic alterations [32].

A gender difference in MetS prevalence has also been observed in Balearic Islands' adolescents. MetS was significantly higher in boys than in girls, which is in accordance with previous data [2]. However, controversy in the gender distribution of MetS has also been pointed out in the literature, and no difference between sexes has also been reported [33].

The proportion of adolescents with ≥1 MetS abnormalities (47.9%) is in accordance with those reported in previous studies [2,29], and suggests that each MetS component worsens with obesity among adolescents [34].

Contrary to previous studies in the Mediterranean area [35], no association was observed between sociodemographic factors (parental educational level, parental socioeconomic status and PAL) and MetS prevalence (data not shown). Some limitations related to PAL should been considered in this study. PA is a complex multi-dimensional exposure which is difficult to measure by self-reported questionnaires in epidemiological studies [36]. Questionnaires have inherent limitations, mainly because they are subjective in nature.

Obese adolescents are particularly at risk for developing MetS, and this has important implications for their future health, especially in coronary heart disease and diabetes [2]. The higher MetS prevalence in obese adolescents compared with overweight adolescents further highlights the importance of a small degree of weight loss to avoid MetS-associated morbidities [37] and demands effective preventive and therapeutic strategies that rely on diet, exercise and lifestyle changes [2].

Gender differences in fasting glycaemia, HDL-cholesterol levels, triglyceridaemia, WC and BP were also observed [38]. Although we have no data on family history of hypertension, an important determinant of high BP, boys

Table 4 Anthropometric variables of body composition with or without a diagnosis of metabolic syndrome.

	Without MetS (n = 341)	With MetS (n = 21)	P-value
Weight (kg)	58.9 (57.9–59.9)	72.5 (68.6–76.5)	0.000
Height (cm)	165.2 (164.5–165.9)	165.9 (163.1–168.8)	0.634
BMI (kg/m^2)	21.5 (21.2–21.8)	26.1 (24.8–27.3)	0.000
BF (%)	22.9 (22.3–23.5)	30.6 (28.3–32.9)	0.000
FFM (kg)	45.1 (44.6–45.7)	50.3 (48.1–52.6)	0.000
TSF (mm)	12.4 (11.9–12.8)	15.4 (13.6–17.2)	0.001
SCSF (mm)	11.2 (10.7–11.7)	18.4 (16.4–20.4)	0.000
WC (cm)	68.6 (67.9–69.3)	79.6 (76.7–82.5)	0.000
HC (cm)	93.2 (92.3–94.0)	102.0 (98.8–105.3)	0.000
WHR	0.74 (0.73–0.74)	0.78 (0.76–0.80)	0.001

Abbreviations: MetS, metabolic syndrome; BMI, body mass index; BF, body fat; FFM, fat-free mass; TSF, triceps skinfold; SCSF, subscapular skinfold; WC, waist circumference; HC, hip circumference; WHR, waist-to-hip ratio.
Data are expressed as mean (95% confidence interval); statistical analysis was performed by ANCOVA, trend analysis, adjusted by sex, age, parental educational level, parental socioeconomic status and physical activity level.

Table 5 Metabolic syndrome components risk (odds ratio, 95% confidence interval) by quartiles of adherence to Mediterranean diet (MD) in boys (n = 143) and girls (n = 219).

	Q1[a]	Q2	Q3	Q4	*P* for trend
n (boys/girls)	35/55	33/52	38/55	37/57	
Metabolic syndrome criteria					
Glucose (≥6.1 mmol/L)					
All subjects	1	1.53 (0.63–2.89)	1.35 (0.52–2.73)	0.89 (0.40–1.90)	0.940
Girls	1	1.62 (0.55–3.13)	1.23 (0.46–3.97)	0.97 (0.51–2.35)	0.905
Boys	1	1.17 (0.38–4.35)	0.81 (0.24–2.74)	0.84 (0.15–2.26)	0.998
Triglycerides (≥1.1 mmol/L)					
All subjects	1	1.00 (0.46–2.20)	0.93 (0.42–2.07)	0.72 (0.31–1.77)	0.019
Girls	1	1.26 (0.44–3.62)	1.03 (0.35–3.05)	0.57 (0.16–2.03)	0.006
Boys	1	1.43 (0.50–4.16)	0.83 (0.26–2.69)	0.25 (0.05–1.27)	0.007
HDL-cholesterol (<1.3 mmol/L; boys aged 15 to 17 years <1.17 mmol/L)					
All subjects	1	0.65 (0.30–1.37)	0.59 (0.27–1.32)	0.43 (0.19–0.99)	0.008
Girls	1	1.00 (0.33–2.99)	0.56 (0.15–2.04)	0.25 (0.05–0.27)	0.002
Boys	1	0.58 (0.20–1.69)	0.48 (0.17–1.39)	0.42 (0.14–1.25)	0.015
Waist circumference (>75th percentile for age and sex)					
All subjects	1	1.33 (0.59–2.01)	0.81 (0.33–1.99)	1.31 (0.59–2.89)	0.601
Girls	1	1.48 (0.54–2.09)	0.71 (0.21–2.41)	1.56 (0.63–3.66)	0.150
Boys	1	1.34 (0.62–1.90)	0.94 (0.25–3.56)	1.06 (0.29–3.82)	0.488
Hypertension (>90th percentile for age, sex and height)					
All subjects	1	0.97 (051–1.85)	0.92 (0.48–1.74)	1.09 (0.58–2.06)	0.964
Girls	1	1.01 (0.41–2.46)	1.02 (0.43–2.44)	1.58 (0.69–3.66)	0.659
Boys	1	0.89 (0.35–2.29)	0.79 (0.30–2.04)	0.64 (0.24–1.74)	0.843

[a] Quartiles of adherence to the MD. The multivariate logistic regression was adjusted for sex, age, parental educational level, parental socioeconomic status and physical activity level. Multiple logistic regression was used to assess the association between MD quartiles (dependent variables) and each of the MetS components (dependent variables). Multiple logistic regression models with polynomial contrast were used to generate *P* for trend.

showed high SBP, which is in agreement with previous studies [39], and longitudinal studies have confirmed the presence of a sex difference in the risk of higher SBP levels during adolescence [40]. The risk of boys showing a higher SBP compared to girls increases in magnitude during adolescence, likely accounting for the higher prevalence of hypertension among men compared with women in young and middle-aged adults [41].

There are discrepancies in the literature about the prevalence of MetS components, which changes according to the definitions used. In developed countries, low HDL-cholesterol levels, and high triglyceridaemia and hypertension were the most common MetS factors, whereas high fasting glycaemia was the least common [2]. In developing countries, high fasting triglyceridaemia was the most common MetS factor, whereas low HDL-cholesterol level was the least common [42]. The prevalence of MetS factors in Balearic Islands' adolescents follows the pattern in developed countries when we stratified by the presence or absence of MetS.

Several epidemiological studies have assessed the relationship between MetS and the adherence to the MD in adults. A longitudinal study on university students [43] reported an inverse association with MetS, but two cross-sectional studies in adults [44,45] found contradictory results. A clinical trial [46] showed the lowest cumulative incidence of MetS in subjects with the highest adherence to MD. A cross-sectional study in high cardiovascular risk subjects [7] showed that high adherence to MD is associated with a low prevalence of the MetS criteria.

Studies in children and adolescents exploring potential associations between either adherence to MD or intake of some of its beneficial compounds and clinical problems are scarce [8,9], and to the best of our knowledge, this association has never been explored in adolescent populations. Our findings show that a high adherence to MD in adolescents is associated with a low prevalence of lipid abnormalities (TGs and HDL). In young male Greek navy recruits (22.5 ± 2.8 years), MD did not significantly influence the presence of MetS [9], which was attributed by the authors to the overall low adherence of the studied cohort to MD. However, our population showed higher adherence to MD than those young male Greeks.

We cannot discuss the MD loss among adolescents in the Balearic Islands, because there are no previous data. However, the findings that half of Balearic Islands' adolescents, both boys and girls, were above the median adherence to MD suggest that the prevalence of metabolic disorders could soon increase among them. Because low adherence to MD was common among adolescents with low parental educational level (data not shown), promotion programmes targeted at parents and adolescents are needed.

Our study was a cross-sectional analysis, which limits assumptions about the duration of any MetS criteria, and so causal inferences cannot be made. However, previous studies [40,41] demonstrated that high triglyceridaemia and BP in childhood are directly associated with further high levels in adulthood.

To sum up, half of the Balearic Islands' adolescents had at least one of the MetS components and a significant number of them, especially the obese, had MetS. These findings demonstrate an emerging health problem in the Balearic Islands because the number of overweight and obese adolescents is increasing worldwide, and most of them will become obese adults and they are more likely to develop MetS. A dramatic increase in the incidence of MetS may represent only the tip of the iceberg and may herald the emergence of an epidemic of advanced cardiovascular disease due to the synergistic effects of MetS components, as obese adolescents become obese young adults [34]. The inverse association between adherence to the MD and MetS suggests that a higher adherence to the MD may hinder the development of detrimental mechanisms involved in the genesis of these metabolic disorders. Therefore, effective preventive and therapeutic strategies to promote the MD and healthy lifestyle habits are necessary in youth and throughout their adulthood.

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Conflict of interest

The authors state that there are no conflicts of interest.

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Manuscrit III

Western and Mediterranean dietary patterns among Balearic Islands' adolescents: socio-economic and lifestyle determinants.

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Western and Mediterranean dietary patterns among Balearic Islands' adolescents: socio-economic and lifestyle determinants

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Abstract

Objective: To assess prevailing food patterns among Balearic Islands' adolescents, and socio-economic and lifestyle determinants.
Design: Cross-sectional nutritional survey carried out (2007–2008) in the Balearic Islands, a Mediterranean region. Dietary assessment was based on a 145-item semi-quantitative FFQ and two non-consecutive 24 h recalls. Anthropometric measurements and questions related to socio-economic, lifestyle, physical activity and body image were assessed.
Setting: Data obtained from a representative sample of all inhabitants living in the Balearic Islands aged 12–17 years.
Subjects: A random sample (n 1231) of the adolescent population (12–17 years old) was interviewed.
Results: Factor analysis identified two major dietary food patterns: 'Western' and 'Mediterranean'. The 'Western' dietary pattern was higher among boys than girls, associated with spending ≥4 h/d on media screen time, but less prevalent among those adolescents who desired a thinner body and those girls who desired to remain the same weight. The 'Mediterranean' dietary pattern was mainly followed by girls, and also boys who spent <2 h/d on media screen time and girls with high parental socio-economic status.
Conclusions: The present study shows the existence of two major dietary patterns among Balearic Islands' adolescents: 'Western' and 'Mediterranean', but girls are more 'Mediterranean' than boys. This evidence supports that the food pattern of Balearic Islands' adolescents is in a transitional state characterised by the loss of the traditional Mediterranean dietary pattern towards a Western dietary pattern. Low parental socio-economic status, much leisure-time on sedentary behaviours such as media screen time and body image are factors associated with the 'Western' dietary pattern.

Keywords
Adolescents
Food patterns
Balearic Islands
Western diet
Mediterranean diet

Adolescence is a transitional stage during which many changes take place at physiological and behavioural levels, representing an important life stage for the development of healthy nutrition behaviour[1]. Many different factors influence food habits in a complex interactive way[2]. Socio-economic and lifestyle factors (parental occupational status, maternal level of education, cultural and/or religious habits, the role of family and patterns of beauty) have a strong influence on eating habits in adolescents[3].

Epidemiological evidence suggests that dietary patterns in the Mediterranean countries are changing rapidly, with an increased consumption of animal products and saturated fat and a decline in intake of basic foodstuffs based on vegetables[4]. Recent nutritional surveys carried out in Spain also confirmed a progressive departure from the traditional Mediterranean diet towards a Western dietary pattern, mainly in young generations[5–11]. Because there is evidence that nutritional behaviours track from adolescence into adulthood, the promotion of healthy nutrition during adolescence has the potential to confer significant long-term health benefits[1].

Despite the worldwide promotion of the Mediterranean dietary pattern, a progressive shift to a non-Mediterranean pattern could be also developing among Balearic Islands' adolescents. Therefore, the aim of the present study was to assess prevailing food patterns among adolescents living in the Balearic Islands, as well as socio-economic and lifestyle determinants.

Methods

Study design

The study is a population-based cross-sectional nutritional survey carried out (2007–2008) in the Balearic Islands, a Mediterranean region.

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Selection of participants, recruitment and approval

The target population consisted of all inhabitants living in the Balearic Islands aged 12–17 years. The sample population was derived from residents aged 12–17 years registered in the scholar census of the Balearic Islands. The theoretical sample size was set at 1500 individuals in order to provide a specific relative precision of 5 % (type I error = 0·05; type II error = 0·10), taking into account an anticipated 70 % participation rate. The sampling technique included stratification according to municipality size, age and sex of inhabitants, and randomisation into subgroups, with Balearic Islands municipalities being the primary sampling units and individuals within the schools of these municipalities comprising the final sampling units. The interviews were performed at the schools. The final sample size was 1231 individuals (82 % participation). The main reason for non-participation was the adolescent declined to be interviewed, or the parents did not authorise the interview.

Ethics

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

Dietary assessment

Dietary questionnaires included two non-consecutive 24 h diet recall periods, one in the warm season (May–September) and one in the cold season (November–March) to account for the influence of seasonal variations, and a semi-quantitative FFQ that has previously been validated[12] and applied in other studies and surveys on the Spanish population[9,10,13,14]. The FFQ, which asked the participant 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 it easy for the interviewee to answer) 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. The period of consumption of seasonal items was also considered. Edible fractions of foods were recorded in the database. The FFQ foods items were collapsed to twenty-nine food groups (Table 2) that may have practical importance in the daily diet and closely approximated food groups previously reported[15,16]. To account for day-to-day intake variability, the questionnaires were administered homogeneously from Monday to Sunday. Well-trained dietitians administered the recalls and verified and quantified the food records.

To estimate volumes and portion sizes, the household measures found in the participants' own homes were used. Conversion of food into nutrients was made using a computer program (ALIMENTA®; NUCOX, Palma, Spain) based on Spanish[17,18] and European[19] food composition tables, and complemented with food composition data available for Majorcan food items[20]. Identification of misreporters was conducted on the basis of the ratio of energy intake (EI) to BMR. EI:BMR < 0·92 (boys) and < 0·85 (girls) was considered to represent under-reporting[21], while EI:BMR ≥ 2·4 was considered to represent over-reporting[22,23]. Under-reporters (20 %) and over-reporters (2 %) were excluded from the analysis.

Socio-economic and lifestyle determinants

A questionnaire incorporating the following questions was used: age group; parental educational level (grouped according to years and type of education: low, < 6 years; medium, 6–12 years; high, > 12 years); and parental socio-economic level (based on the occupation of parents and classified as low, medium and high, according to the Spanish Society of Epidemiology)[24]. The number of daily meals and snacks was calculated from the total eating occasions that participants declared among the following: breakfast; mid-morning snack; lunch; mid-afternoon snack; dinner; before going to sleep; others. Three groups of eating frequency were considered: ≤ 3, 4 and ≥ 5 times/d.

Physical activity patterns

Physical activity was evaluated according to the guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ)[25] in the short form and its specific modification for adolescents (IPAQ-A)[26]. The specific types of activity assessed were walking, moderate-intensity activities (i.e. physical activity at school) and vigorous-intensity activities (i.e. sports practice). In accordance with the AVENA (Food and Assessment of Nutritional Status of Adolescents) study[27], the questionnaire also included information on television (TV) viewing, computer use and video games in h/d, and usual sleep duration to the nearest 10 min. Physical inactivity was established with a cut-off level of 300 min/week of moderate/vigorous physical activity, in accordance with current guidelines of physical activity for adolescents[28,29].

Assessment of other covariables

Anthropometry and adiposity

Height was determined using a mobile anthropometer (model KaWe 44444; Kirchner & Wilhelm GmbH Co. KG, Asperg, Germany) to the nearest millimetre, with the subject's head in the Frankfurt plane. Body weight was determined to the nearest 100 g using a digital scale (model sc9210; Tefal, Rumilly, France). The subjects were weighed in bare feet and light underwear, which was accounted for by subtracting 300 g from the measured weight. Triceps and subscapular skinfold thickness (ST) were measured using a Holtain skinfold calliper (Tanner/Whitehouse, Crosswell, Crymych, UK) and the mean of three measurements (right arm) was used. Height and weight measures were used to calculate BMI (kg/m^2). Body fat percentage (%BF) was measured from triceps and subscapular ST according to Slaughter *et al.*[30]. This equation has been proposed as the most accurate for estimation of %BF from ST in this particular population of adolescents[31]. %BF and height were used to calculate fat mass index (FMI; kg/m^2).

Defining overweight and obesity

In children and adolescents, BMI for age has been established as the main measurement to define overweight and obesity[32]. However, there are some limitations associated with its use as an indicator of fatness. For example, individuals with increased muscle mass may also have increased BMI[33]. On the other hand, individuals with decreased lean body mass and increased adiposity may also be misclassified by assessment with BMI[33]. Alvero-Cruz *et al.*[34] showed that the FMI had higher accuracy for overweight screening than BMI. The FMI is a useful measure to evaluate body composition parameters by effectively eliminating differences in body fat associated with height[35]. Nevertheless, it is difficult to exclude BMI from the normal-weight and overweight definition. For this reason, a combination of BMI and FMI was used to define overweight and obesity in the present study.

First, subjects were classified using the age- and sex-specific cut-offs developed and proposed for international comparisons by Cole *et al.*[36], recommended for use also by the International Obesity Taskforce. Then, subjects were classified as normal-fat and overfat according to their FMI using the sex-specific cut-offs proposed by Alvero-Cruz *et al.*[34] for adolescents: 4·58 kg/m^2 in boys and 7·76 kg/m^2 in girls. Thus, adolescents were classified into two groups as follows: (i) not at risk (BMI for age and sex < 25 kg/m^2 or BMI ≥ 25 kg/m^2 but FMI $< 4·58$ kg/m^2 in boys and FMI $< 7·76$ kg/m^2 in girls); (ii) overweight/obesity (BMI for age and sex < 25 kg/m^2 or BMI ≥ 25 kg/m^2 but FMI $\geq 4·58$ kg/m^2 in boys and FMI $\geq 7·76$ kg/m^2 in girls). The variable was labelled as 'body composition'.

Body image

Self-perceived body image was measured using the Stunkard scale[37], which consists of silhouette drawings ranging from 1 to 9 with monotonic increments in overweight percentage where 1 is the leanest and 9 the heaviest. Separate figures for boys and girls were used. Participants were asked to identify of the nine body figures: 'Which silhouette looks most like yourself?' and 'Which silhouette would you like to look like?' The difference between perceived body image and desired body image was used to determine the level of dissatisfaction with current body image. Values other than zero represent dissatisfaction with perceived body image. A positive value was indicative of the participant's desire to be thinner than his/her perceived current size, while a negative value reflected the participant's desire to be thicker than his/her current perceived size[38,39].

Statistical analyses

Analyses were performed with the SPSS statistical software package version 19·0 (SPSS Inc., Chicago, IL, USA). Factor analyses by the principal components method and varimax rotation were run on *Z*-scored transformed food consumption variables in order to identify salient food patterns in the group. To interpret the data, only food groups with factor loading $> 0·250$ were retained for each factor. For each adolescent, the factor score for each pattern was calculated. These scores were categorised (quintiles), as is often done in dietary epidemiological studies that relate food patterns to health outcomes when there is not a priori knowledge of the function that best fits the data[40]. Significant differences in prevalence were calculated by means of the χ^2 test. Logistic regression models with the calculations of corresponding adjusted odds ratio and 95 % confidence interval were used to examine differences between adolescents' characteristics and dietary patterns (the fifth quintile (Q5) *v.* the first quintile (Q1) in each dietary pattern). Univariate analysis was first carried out for all of the socio-economic and lifestyle variables that could be associated with dietary patterns. Any factor was considered a candidate for the multivariate model. Multiple logistic regression analyses were used to simultaneously examine the effect of different socio-economic and lifestyle variables on the dietary patterns. Level of significance for acceptance was $P < 0·05$.

Results

Participants' characteristics according to gender are shown in Table 1. Factor analysis retained two major dietary pattern factors which explained 24 % of the total variance: the 'Western' pattern (factor 1, explaining 13·4 % of total variance) and the 'Mediterranean' pattern (factor 2, explaining 10·6 % of total variance; Table 2). Food group categories identified in the 'Western' pattern were yoghurt and cheese, dairy desserts, red meat, poultry, sausages, eggs, bread, cereals, pasta, rice dishes, pizza, fruit juices, canned fruits, nuts, soft drinks, high-fat foods, other oils and fats, sweets and chocolates. Those identified in the 'Mediterranean' pattern included yoghurt and cheese, red meat, poultry, fish and seafood, eggs, legumes, pasta, fresh fruit, fruit juices, vegetables, potatoes and tubercles and olive oil. 'Western' and 'Mediterranean' labels were chosen according to similarities to Western and Mediterranean dietary patterns described elsewhere[41,42]. Despite that nuts are a common Mediterranean food[43], in the present study a higher consumption was associated with the 'Western' pattern. However, this association may be

Table 1 Characteristics of the study population: representative sample of adolescents (aged 12–17 years) living in the Balearic Islands, Spain, 2007–2008

	Boys (*n* 574)	Girls (*n* 657)
	%	%
Age (years)		
12–13	25·8	25·6
14–15	49·3	49·6
16–17	24·9	24·8
Parental educational level		
Low	32·8	36·3
Medium	29·4	32·2
High	37·8	31·5
Parental socio-economic status		
Low	18·4	24·3
Medium	57·6	54·8
High	24·1	20·9
Number of daily meals and snacks		
≤3	27·7	44·1
4	34·9	30·7
≥5	37·4	25·3
Media screen time (h/d)		
<2	14·9	19·0
≥2–<4	43·4	38·1
≥4	41·7	42·9
Sleep time (h/d)		
<7	7·5	8·2
≥7	92·5	91·8
Physical activity		
Inactive	22·9	47·9
Active	77·1	52·1
Body composition		
Not at risk	68·1	77·8
Overweight/obesity	31·9	22·2
Desire to change weight		
To be thinner	35·9	57·7
To remain the same weight	37·7	35·2
To be thicker	26·5	7·1

associated with the higher consumption of nuts found in the Balearic Islands population than in the overall Spanish population[10].

The 'Western' dietary pattern was found more often among boys (OR = 4·47, 95 % CI 2·81, 7·11, $P < 0·001$), while the 'Mediterranean' dietary pattern was mainly followed by girls (OR = 1·43, 95 % CI 0·93, 2·20, $P \geq 0·05$). Associations between dietary patterns and socio-economic and lifestyle determinants stratified by gender were assessed (Table 3 for boys and Table 4 for girls). The 'Western' dietary pattern was associated with spending ≥4 h/d on media screen time in both sexes and with being in the youngest age group (12–13 years) in girls, but was less prevalent among those adolescents who wished to be thinner and those girls who desired to remain the same weight. The 'Mediterranean' dietary pattern was mainly followed by boys who spent <2 h/d on media screen time and girls with low parental socio-economic status. Results also revealed that adolescents who spent ≥4 h/d on media screen time and were in the highest quintile for the 'Western' dietary pattern showed a higher frequency of consumption of milk (OR = 7·86, 95 % CI 1·15, 53·48; $P < 0·05$), soft drinks (OR = 6·15, 95 % CI 1·23, 30·79; $P < 0·05$) and nuts (OR = 4·01, 95 % CI 1·02, 15·80; $P < 0·05$) than their counterparts who spent <4 h/d.

Table 2 Food patterns identified by factor analyses using the principal components method and varimax rotation: representative sample of adolescents (aged 12–17 years) living in the Balearic Islands, Spain, 2007–2008

	Dietary pattern	
Food group category	'Western'	'Mediterranean'
Dairy food		
Milk	–	–
Yoghurt and cheese	0·365	0·280
Dairy desserts	0·628	–
Meat and processed meats		
Red meat	0·502	0·291
Poultry	0·369	0·364
Sausages	0·440	–
Fish and seafood	–	0·295
Eggs	0·382	0·416
Legumes	–	0·450
Cereals, grains and derivatives		
Bread	0·270	–
Cereals	0·284	–
Biscuits	–	–
Pasta	0·265	0·274
Rice dishes	0·270	–
Pizza	0·368	–
Fruits		
Fresh fruits	–	0·426
Fruit juices	0·347	0·277
Canned fruits	0·507	–
Vegetables	–	0·897
Nuts	0·433	–
Potatoes and tubercles	–	0·897
Drinks		
Soft drinks	0·620	–
Tea and coffee	–	–
Alcoholic beverages	–	–
Fats		
High-fat foods	0·614	–
Olive oil	–	0·366
Other oils and fats	0·388	–
Sweets and desserts		
Sweets	0·598	–
Chocolates	0·424	–

Food group factor loadings: only food groups with factor loading >0·250 were retained for each factor. Only adolescents who did not misreport their energy intake were considered for this analysis.

In boys, the univariate analysis also showed that the 'Western' dietary pattern was associated with being in the youngest age group (12–13 years), low parental socio-economic status, spending ≥4 h/d on media screen time, not being at risk of overweight or obesity and the wish to be thinner; whereas being in the middle age group (14–15 years) and spending <2 h/d on media screen time were associated with the 'Mediterranean' pattern. In girls, low parental educational level, low socio-economic status and spending ≥2 h/d on media screen time were associated with the 'Western' dietary pattern; whereas medium or high parental educational level, high parental socio-economic status and spending <2 h/d on media screen time were associated with the 'Mediterranean' pattern. Results also revealed a negative association between age and a desire to maintain the same body shape or a lower

Table 3 Socio-economic and lifestyle determinants of 'Western' and 'Mediterranean' dietary patterns among adolescent boys, Balearic Islands, Spain, 2007–2008

	'Western'							'Mediterranean'						
			Q1 *v.* Q5							Q1 *v.* Q5				
	Q1 %	Q5 %	*P*	Crude OR†	95% CI	Adjusted OR‡	95% CI	Q1 %	Q5 %	*P*	Crude OR†	95% CI	Adjusted OR‡	95% CI
Age group (years)														
12–13	44·4	55·6	0·108	0·36*	0·14, 0·98	0·47	0·12, 1·80	40·5	59·5	0·091	2·59*	1·07, 6·28	2·07	0·67, 6·35
14–15	29·4	70·6		0·70	0·28, 1·73	0·75	0·22, 2·53	57·5	42·5		1·30	0·61, 2·77	1·24	0·48, 3·21
16–17	22·5	77·5		1·00	Ref.	1·00	Ref.	63·8	36·2		1·00	Ref.	1·00	Ref.
Parental educational level														
Low	31·1	68·9	0·363	1·43	0·61, 3·33	1·67	0·42, 6·72	65·2	34·8	0·128	0·47	0·21, 1·03	0·49	0·16, 1·49
Medium	25·6	74·4		1·88	0·77, 4·55	1·77	0·52, 6·00	60·9	39·1		0·56	0·26, 1·23	0·93	0·33, 2·57
High	39·2	60·8		1·00	Ref.	1·00	Ref.	46·6	53·4		1·00	Ref.	1·00	Ref.
Parental socio-economic status														
Low	13·3	86·7	0·038	4·69*	1·32, 16·74	3·22	0·56, 18·45	45·7	54·3	0·047	1·05	0·40, 2·74	1·32	0·37, 4·71
Medium	35·1	64·9		1·33	0·57, 3·15	0·65	0·17, 2·49	66·7	33·3		0·44	0·19, 1·02	0·58	0·20, 1·71
High	41·9	58·1		1·00	Ref.	1·00	Ref.	46·9	53·1		1·00	Ref.	1·00	Ref.
Number of daily meals and snacks														
≤3	38·7	61·3	0·347	0·53	0·21, 1·31	0·93	0·25, 3·48	63·2	36·8	0·577	0·66	0·29, 1·50	0·73	0·25, 2·14
4	33·3	66·7		0·67	0·29, 1·55	1·21	0·39, 3·77	53·8	46·2		0·97	0·47, 2·02	0·83	0·32, 2·13
≥5	25·0	75·0		1·00	Ref.	1·00	Ref.	53·1	46·9		1·00	Ref.	1·00	Ref.
Media screen time (h/d)														
<2	57·7	42·3	0·001	0·15***	0·05, 0·41	0·11**	0·03, 0·47	41·2	58·8	0·011	3·05*	1·30, 7·14	3·59 *	1·33, 9·68
≥2–<4	34·6	65·4		0·38*	0·16, 0·92	0·23*	0·06, 0·83	45·7	54·3		2·54*	1·18, 5·49	2·93*	1·11, 7·71
≥4	16·7	83·3		1·00	Ref.	1·00	Ref.	68·1	31·9		1·00	Ref.	1·00	Ref.
Sleep time (h/d)														
<7	16·7	83·3	0·255	2·42	0·51, 11·51	1·73	0·17, 17·32	54·5	45·5	0·952	1·04	0·30, 3·56	2·00	0·30, 3·56
≥7	32·6	67·4		1·00	Ref.	1·00	Ref.	55·5	44·5		1·00	Ref.	1·00	Ref.
Physical activity														
Inactive	40·9	59·1	0·103	0·56	0·26, 1·19	0·53	0·19, 1·52	65·0	35·0	0·149	0·58	0·27, 1·22	1·02	0·37, 2·84
Active	28·0	72·0		1·00	Ref.	1·00	Ref.	51·8	48·2		1·00	Ref.	1·00	Ref.
Body composition														
Not at risk	26·4	73·6	0·037	2·26*	1·04, 4·88	0·95	0·26, 3·50	56·8	43·2	0·549	0·80	0·39, 1·66	0·55	0·39, 1·66
Overweight/obesity	44·7	55·3		1·00	Ref.	1·00	Ref.	51·3	48·7		1·00	Ref.	1·00	Ref.
Desire to change weight														
To be thinner	57·6	42·4	0·000	0·18**	0·06, 0·48	0·18*	0·04, 0·86	55·6	44·4	0·430	1·38	0·60, 3·15	0·97	0·25, 3·69
To remain the same weight	24·1	75·9		0·74	0·29, 1·91	0·88	0·27, 2·87	50·8	49·2		1·67	0·77, 3·61	1·51	0·56, 4·06
To be thicker	19·1	80·9		1·00	Ref.	1·00	Ref.	63·3	36·7		1·00	Ref.	1·00	Ref.

Q1, first quintile; Q5, fifth quintile; Ref., reference category.
†Univariate analysis (logistic regression analysis considering the effect of one explanatory variable).
‡Multivariate analysis (multiple logistic regression analysis considering the simultaneous effect of all explanatory variables). Only adolescents who did not misreport their energy intake were considered for this analysis.
Significant differences between Q5 and Q1 in each dietary pattern (χ^2 test): *$P<0·05$, **$P<0·01$, ***$P<0·001$.

Table 4 Socio-economic and lifestyle determinants of 'Western' and 'Mediterranean' dietary patterns among adolescent girls, Balearic Islands, Spain, 2007–2008

	'Western'							'Mediterranean'						
			Q1 *v.* Q5								Q1 *v.* Q5			
	Q1 %	Q5 %	*P*	Crude OR†	95% CI	Adjusted OR‡	95% CI	Q1 %	Q5 %	*P*	Crude OR†	95% CI	Adjusted OR‡	95% CI
Age group (years)														
12–13	51·3	48·7	0·005	5·16**	1·86, 14·33	4·30*	1·13, 16·37	43·5	56·5	0·679	0·96	0·41, 2·26	1·36	0·42, 4·41
14–15	65·4	34·6		2·87*	1·17, 7·05	2·77	0·89, 8·55	49·5	50·5		0·76	0·36, 1·59	1·15	0·45, 2·92
16–17	84·4	15·6		1·00	Ref.	1·00	Ref.	42·5	57·5		1·00	Ref.	1·00	Ref.
Parental educational level														
Low	54·1	45·9	0·038	2·44*	1·14, 5·22	0·90	0·27, 3·03	59·3	40·7	0·005	0·28**	0·13, 0·61	0·65	0·21, 2·03
Medium	71·4	28·6		1·15	0·52, 2·53	0·45	0·14, 1·43	46·7	53·3		0·47	0·22, 1·02	0·70	0·25, 1·99
High	74·2	25·8		1·00	Ref.	1·00	Ref.	29·1	70·9		1·00	Ref.	1·00	Ref.
Parental socio-economic status														
Low	50·0	50·0	0·005	4·50**	1·72, 11·75	3·75	0·93, 15·17	66·7	33·3	0·000	0·14***	0·05, 0·40	0·13**	0·03, 0·54
Medium	69·7	30·3		1·96	0·81, 4·77	2·15	0·68, 6·82	42·1	57·9		0·39*	0·15, 0·98	0·32	0·10, 1·08
High	81·8	18·2		1·00	Ref.	1·00	Ref.	21·9	78·1		1·00	Ref.	1·00	Ref.
Number of daily meals and snacks														
⩽3	67·5	32·5	0·004	0·46*	0·22, 0·97	0·58	0·21, 1·56	46·8	53·2	0·837	0·84	0·41, 1·74	0·49	0·18, 1·33
4	79·0	21·0		0·25**	0·11, 0·59	0·40	0·14, 1·15	48·2	51·8		0·80	0·37, 1·74	0·69	0·25, 1·89
⩾5	48·9	51·1		1·00	Ref.	1·00	Ref.	42·6	57·4		1·00	Ref.	1·00	Ref.
Media screen time (h/d)														
<2	82·4	17·6	0·028	0·29*	0·11, 0·78	0·23*	0·05, 0·99	28·1	71·9	0·062	2·76*	1·13, 6·73	1·82	0·62, 5·40
⩾2–<4	70·5	29·5		0·56	0·28, 1·10	0·51	0·22, 1·18	50·0	50·0		1·08	0·56, 2·09	0·85	0·38, 1·90
⩾4	57·1	42·9		1·00	Ref.	1·00	Ref.	51·9	48·1		1·00	Ref.	1·00	Ref.
Sleep time (h/d)														
<7	71·4	28·6	0·715	0·80	0·24, 2·66	0·99	0·21, 4·69	41·7	58·3	0·731	1·23	0·38, 4·03	1·03	0·26, 3·99
⩾7	66·7	33·3		1·00	Ref.	1·00	Ref.	46·8	53·2		1·00	Ref.	1·00	Ref.
Physical activity														
Inactive	67·8	32·2	0·943	0·98	0·53, 1·80	0·90	0·39, 2·06	51·6	48·4	0·132	0·63	0·35, 1·15	0·69	0·31, 1·50
Active	67·3	32·7		1·00	Ref.	1·00	Ref.	40·2	59·8		1·00	Ref.	1·00	Ref.
Body composition														
Not at risk	65·6	34·4	0·278	1·57	0·69, 3·59	1·41	0·45, 4·38	48·7	51·3	0·205	0·59	0·25, 1·35	0·34	0·12, 1·01
Overweight/obesity	75·0	25·0		1·00	Ref.	1·00	Ref.	35·7	64·3		1·00	Ref.	1·00	Ref.
Desire to change weight														
To be thinner	74·5	25·5	0·000	0·08***	0·02, 0·30	0·13*	0·03, 0·63	45·3	54·7	0·194	3·22	0·81, 12·82	3·27	0·63, 16·94
To remain the same weight	69·7	30·3		0·10**	0·03, 0·39	0·17*	0·03, 0·82	43·9	56·1		3·40	0·83, 13·98	4·44	0·87, 22·80
To be thicker	18·8	81·3		1·00	Ref.	1·00	Ref.	72·7	27·3		1·00	Ref.	1·00	Ref.

Q1, first quintile; Q5, fifth quintile; Ref., reference category.
†Univariate analysis (logistic regression analysis considering the effect of one explanatory variable).
‡Multivariate analysis (multiple logistic regression analysis considering the simultaneous effect of all explanatory variables). Only adolescents who did not misreport their energy intake were considered for this analysis.
Significant differences between Q5 and Q1 in each dietary pattern (χ^2 test): $^*P<0·05$, $^{**}P<0·01$, $^{***}P<0·001$.

one and 'Western' dietary pattern in girls; whereas it was positively related to the 'Mediterranean' dietary pattern (despite the lack of statistical significance). To consume < 5 daily meals was associated with a low probability to follow a 'Western' dietary pattern among girls, but this variable lost statistical significance after being adjusted for all explanatory variables.

Discussion

The Mediterranean dietary pattern has been widely reported to be a model of healthy eating for its contribution to favourable health status and best quality of life. However, a progressive shift to a non-Mediterranean pattern, even in countries bordering the Mediterranean Sea, has been observed[44]. Previous studies carried out in Spain confirmed that young generations[5–11] are further away from the Mediterranean dietary pattern. Lately, we found that the average adherence to the Mediterranean dietary pattern in our adolescent population was 58 %[11]. The present study has identified two major dietary patterns among adolescents ('Western' and 'Mediterranean'), supporting evidence for a nutrition transition from a traditional healthy diet towards a Western diet among Mediterranean youth. The literature has reported that girls paid more attention to foods than boys, met nutritional recommendations, and tried to prevent or reverse the obese state and improve health status[45]. Accordingly, we found that girls were more likely to follow the 'Mediterranean' but not the 'Western' dietary pattern than boys.

Socio-economic and lifestyle characteristics are important determinants of the health status in a community. Parental educational level and socio-economic status have a marked effect on children's and adolescents' lifestyles and dietary habits[46]. In previous studies, we found that maternal educational level was associated with diet quality[9] and adherence to the Mediterranean dietary pattern[11]. Moreover, low socio-economic status and maternal educational level have also been related to high consumption of sweets, high-fat bakery products, sugary and salty snacks[5,47–49]. It has also been pointed out that food cost is another factor that may influence people's dietary choices, and to follow a 'Mediterranean' dietary patterns is usually more expensive than following a 'Western' one[50]. Our study shows that low parental socio-economic status is strongly associated with the 'Western' pattern, whereas high parental socio-economic status is associated with the 'Mediterranean' pattern.

Children and adolescents usually spend much leisure time on sedentary behaviours, such as TV viewing, computer use and video games, collectively known as screen time[28]. An association between watching TV for > 2 h/d and major consumption of high-fat snacks and high-sugar drinks has been demonstrated[5,51]. TV is clearly related to exposure to the advertising of unhealthy foods[45]. However, whereas media screen time was a good proxy for either dietary pattern in the present study, no significant differences were observed when TV and computer use were assessed separately. Thus, adolescents who spent ≥ 4 h/d on media screen were more likely to follow a 'Western' dietary pattern. However, those who spent < 2 h/d showed the highest probability for a 'Mediterranean' dietary pattern.

Physical activity level has been associated with food choice, and cereals, fruits and vegetables often appear in the diet of active adults and children[52]. Children who follow a healthy diet are those who might also maintain high levels of physical activity[53]. Despite no significant association between physical activity and the dietary patterns being obtained in the present study, in a previous study we found that sedentary and low-active adolescents showed the lowest adherence to the Mediterranean dietary pattern[11].

On the other hand, no statistically significant association between dietary patterns ('Western' and 'Mediterranean') and sleep time was found in the present study. Taheri[54] suggested that sleep loss leads to more opportunities for food intake. The evidence linking sleep and weight has been stronger for younger children and adults[55,56]. In a previous work we found that short sleep (< 7 h/d) was associated with obesity compared with longer sleep in boys, whereas no association was found in girls[57]. Recently Lytle *et al.*[58] have found more evidence for younger adolescents as compared with older adolescents. Despite that further studies are needed, adequate sleep during this critical time period is important[58].

Despite finding no significant association between number of daily meals and snacks and dietary patterns, the present results indicated that ≥ 5 eating occasions per day may promote high daily consumption of energy-dense foods and drinks. However, meal pattern and omission of meals, especially skipped breakfast, have also been suggested as markers of an inappropriate dietary intake among adolescents[59], and in a previous study eating frequency was identified as a risk factor for obesity in both boys and girls[57]. Therefore, a promotion of at least 5 daily meals and snacks should be considered in nutrition education programmes for adolescents aimed at reducing risk of disease. However, education programmes could also focus on strategies to promote healthy food choices following the Mediterranean diet.

Our results also revealed that adolescents without risk to be overweight or obese were more likely to follow the 'Western' dietary pattern than the 'Mediterranean' dietary pattern (despite that statistical significance was found only in boys). The Mediterranean diet is an example of a healthy diet[42]. However, controversial results in adherence to the Mediterranean diet and obesity in children and adolescents have been found in the literature. Some studies observed an inverse association between Mediterranean dietary pattern and BMI[53,60,61], but others found no correlation[62]. On the other hand, a study among 2513 Spanish children and adolescents aged 10–24 years which assessed adiposity by waist circumference and weight:hip ratio found an inverse association of both indicators with adherence to the Mediterranean diet[63]. We have also previously observed that both obese boys and girls avoided sweets and salty snacks consumption to counteract the obesity[57].

Body image has been found to be a powerful determinant of adolescent nutritional habits and food choices[64]; and in the present study a desire for a thinner body shape was associated with low risk for the 'Western' dietary pattern. Therefore, understanding how satisfaction with current body shape affects food preferences and the overall adolescent diet is a key issue for the development of strategies aimed at influencing dietary behaviour.

Limitations of the study

Dietary and physical activity data were based on self-reports[16]. The literature reports that food under-reporting is usually associated with gender and weight status[65,66]. Self-report of physical activity also can lead to over-report the physical activity due to social desirability bias, and therefore the number of inactive individuals may be greater than that reported[67,68], especially among children and adolescents, and also among the obese[67]. However, in many cases, self-reporting is the only feasible method of assessing physical activity[69] and dietary intake in epidemiological studies. Although epidemiologists made every effort to get as accurate data as possible, there is a possibility that misreporting occurred[16].

The FFQ did not differentiate between wholegrain and white bread. However, Ribas-Barba *et al.*[70] found a slight percentage of daily wholegrain consumers (14·2 %) among the Catalonia population aged 10–75 years, with a high percentage of never consumers of wholegrain bread (71·3 %). Therefore, we would expect that bread, which was one of the main foods related to the 'Western' dietary pattern in the present study, was consumed mostly as white bread.

The statistical methods usually applied in nutritional epidemiology to define dietary patterns based on collected dietary information contain a posteriori approaches, such as cluster and factor analyses, and a priori dietary index approaches[40]. In the present study an exploratory statistical analysis based on factor analyses was chosen. Factor analysis is a useful technique to summarise food patterns and relate them to different socio-economic and lifestyle factors[5] and body self-perception. However, it must be acknowledged that the method is data-specific, thus the patterns and their associations extracted in one study population may not be reproduced in other populations[5,71]. This kind of analysis can facilitate the development of interventions aimed at modifying eating patterns, rather than specific components of the diet[5].

Body fat was calculated using Slaughter *et al.*'s equations [30] which have been suggested previously by Rodríguez *et al.*[31]. However, the present study did not take into account pubertal development despite that chronological age may vary dramatically during this phase. Therefore, as in a previous study[72] in which adolescents have been classified according to their pubertal stage, boys were divided into two groups: pubertal (12–14 years old) and post-pubertal (15–17 years old).

Conclusions

The present study shows the existence of two major dietary patterns among Balearic Islands' adolescents: 'Western' and 'Mediterranean', but girls are more 'Mediterranean' than boys. This evidence supports that the food pattern of Balearic Islands' adolescents is in a transitional state characterised by the loss of the traditional Mediterranean dietary pattern towards a Western dietary pattern. Low parental socio-economic status, much leisure time on sedentary behaviours such as media screen time and body image are factors associated with the 'Western' dietary pattern.

Adolescents constitute priority targets for action and should be more aware about the Mediterranean diet and its health benefits. Programmes to promote the traditional Mediterranean dietary pattern among not only adolescents but also their families, combined with an active lifestyle, would likely result in a more favourable future health profile.

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Manuscrit IV

Meal frequency, adiposity and food quality among the Balearic Islands' adolescents.

Bibiloni MM, Pich J, Pons A, Tur JA.

Meal frequency, adiposity and food quality among the Balearic Islands' adolescents

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Abstract

Background: An inverse association between eating frequency and the prevalence of overweight and obesity has been suggested.

Objectives: To assess the association between eating frequency and overall (BMI and BF) and central (WHtR) adiposity among adolescents, but also the association between eating frequency and dietary intake, food consumption, and diet quality (on the basis of the Mediterranean Diet).

Methods: A cross-sectional nutritional survey was carried out (2007-2008). A random sample (n=1231) of the adolescent population (12-17 y-o) was interviewed. Dietary assessment was based on a food-frequency questionnaire and two non-consecutive 24-h recalls. The eating frequency was the average of daily meals and snacks. Anthropometric measurements and questions related to socioeconomic, lifestyle, physical activity and body image were also used.

Results: BMI, WC, WHtR and BF were inversely associated with eating frequency. Risk of overall & central obesity increased at eating ≤3 occasions/day in both boys (OR: 4.56, 95%CI: 1.47-14.13; *P*<0.01) and girls (OR: 3.76; 95%CI: 1.03-13.79; *P*<0.05). Snacks were inversely correlated with BMI, BF and WHtR despite that energy intake was higher adolescents with ≥5 eating occasions/day. Adolescents with ≤3 eating occasions/day took half of energy at lunch and dinner, whereas only a third of energy was taken at these meals in those adolescents with ≥5 eating occasions/day. Overall, 4 eating occasions/day in girls and 4 or more eating occasions/day in boys were associated with higher probability of an optimal quality diet. In boys, ≥eating occasions/day was associated to breakfast daily and daily consumption of fruits and yogurt & cheese. In girls, comparing to ≤3 eating occasions/day with girls who ate 4 occasions/day revealed a higher consumption of breakfast cereals but lower consumption of other oils & fats and high fat foods. Contrarily, 5 eating occasions/day was associated to higher consumption of commercially baked foods or pastries for breakfast.

Conclusions: To increased meal frequency may have benefits on reducing overall and central adiposity. A promotion of at least 5 daily meals and snacks should be considered. In addition, programs it should be focused to the promotion of healthy food choices following the Mediterranean diet, especially in girls.

Keywords: overall & central adiposity, energy intake, eating frequency, adolescents, Mediterranean diet.

Introduction

Adolescence is a time of rapid physiologic, psychological, and social development influencing nutrient needs as well as individual's ability to supply those needs. Disruptions in the balance between nutrient requirements and intake during adolescence have an impact on major health problems. It has been hypothesized that early adoption of healthy eating habits may contribute to a lower incidence of chronic diseases and improved quality of life in adulthood and later ages [1]. It has been also suggested that to find associations between dietary factors and obesity in adolescence, eating patterns should be considered, including behaviors such as meal frequency [2].

Meal frequency has been defined as a particularly important variable to be considered when designing culturally specific obesity prevention and treatment programs [3]. Eating greater number of meals per day has been associated with lower likelihood of obesity in adolescents, mainly using BMI [4-7], because of their feasibility under clinical settings and in epidemiological studies to define overweight and obesity. Adolescents with a better food quality showed a lower BMI, which implies a connection between the food quality of an individual's diet and his or her BMI [2,8]. However, BMI fails to assess the accumulation of abdominal fat, which mainly increases the risk of no transmittable chronic diseases [9]. Therefore, it would be interesting to find associations between meal frequency, adiposity and food quality in adolescents.

The prevalence of overweight (12.7%) and obesity (8.5%) and the risk factors for obesity among the Balearic Islands' adolescent population has been previously estimated [10], and meal frequency has been identified as a risk factor for obesity in both sexes. Therefore, the aim of this study was to assess the association between meal frequency, adiposity and food quality among the Balearic Islands' adolescents.

Material and methods

Study design

The study is a population-based cross-sectional nutritional survey carried out in the Balearic Islands (2007-2008).

Selection of participants, recruitment and approval

A multicenter study was performed on Balearic Islands' adolescents aged 12–17 years. The population was selected by means of a multiple-step, simple random sampling, taking into account first the location (Palma de Mallorca, Calvià, Inca, Manacor, Maó, Eivissa, Llucmajor, Santa Margalida, S'Arenal, Sant Jordi de Ses Salines) and then by random assignment of the schools within each city. Sample size was stratified by age and sex. The socioeconomic variable was considered to be associated to geographical location and type of school. As the selection of schools was done by random selection and fulfilling quota, this variable was also considered to be randomly assigned.

To calculate the number of adolescents to be included in the study in order to guarantee a representative sample of the whole Balearic Islands, we selected the variable with the greatest variance for this age group from the data published in the literature at the time the study was planned; that was BMI [11]. The sampling was determined for the distribution of this variable; the CI was established at 95% with an error ± 0.25. The established number of subjects was 1,500. The total number of subjects was uniformly distributed in the cities and proportionally distributed by sex and age group. Exclusion criteria were: type 2 diabetes, pregnancy, alcohol or drug abuse, and non-directly related nutritional medical conditions.

The sample was oversized to prevent loss of information and as necessary to do the fieldwork in complete classrooms. In each school, all the adolescents of one classroom were proposed to participate in the survey. A letter about the nature and purpose of the study informed parents or legal tutors. After receiving their written consent, the adolescents were considered for inclusion in the study. After finishing the field study, the adolescents who did not fulfil the inclusion criteria were excluded. Finally, the sample was adjusted by a weight factor in order to balance the sample in accordance to the distribution of the Balearic Islands' population and to guarantee the representativeness of each of the groups, already defined by the previously mentioned factors (age and sex). The final number of subjects included in the study was 1,231 adolescents (82% participation). The reasons to not participate were (a) the subject declined to be interviewed, and (b) the parents did not authorize the interview.

This 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 (Palma de Mallorca, Spain).

Anthropometric measurements and adiposity

Height was determined using a mobile anthropometer (Kawe 44444, Asperg, Germany) to the nearest millimetre, with the subject's head in the Frankfurt plane. Body weight was determined to the nearest 100g using a digital scale (Tefal, sc9210, France). The subjects were weighed in bare feet and light underwear. Waist circumference (WC) and hip circumference (HC) were measured using a non-stretchable measuring tape (Kawe, 43972, France). The subjects were asked to stand erect in a relaxed position with both feet together on a flat surface. WC was measured as the smallest horizontal girth between the costal margins and the iliac crests at minimal respiration. Measurements were made to the nearest 0.1 cm. HC was taken as the greatest circumference at the level of greater trochanters (the widest portion of the hip) on both sides. Measurements were made to the nearest 0.1 cm. Triceps and subscapular skinfold thickness were measured at the left side of the using a Holtain skinfold calliper (Tanner/Whitehouse, Crosswell, Crymych, UK), and the mean of three measurements was used. Body fat (BF) was calculated according to the formulas of Slaughter et al. [12]. Height and weight measures were used to calculate body mass index (BMI, kg/m^2) and WC and height were used to calculate waist-to-height ratio (WHtR). BMI and BF are generally used as measures of overall obesity, while WHtR is used as a measure of central obesity. The WHtR cut-offs limits for children and adolescents (WHtR<0.46/0.45; WHtR≥0.45/0.46; boys/girls) have been described elsewhere(15). BF has recently been criticized as inadequately reflecting body-size adjusted adiposity [13], thus Fat Mass Index (FMI; kg/m^2) was used as measure of body composition in the present study [14,15].

Subjects were age- and sex-specific classified using the cut-offs developed and proposed for international comparisons by Cole et al. [16], recommended by IOTF, and then subjects were classified as normal-fat and overfat according to their FMI using the sex-specific cut-offs proposed by Alvero-Cruz et al. [17] for adolescents: 4.58 kg/m^2 in boys and 7.76 kg/m^2 in girls. Thus, adolescents were classified into two weight and fat groups as following:

1) Not at risk (BMI for age and sex <25 kg/m^2; FMI<4.58 kg/m^2 in boys, FMI<7.76 kg/m^2 in girls)

2) Overweight/obesity (BMI for age and sex ≥25-BMI kg/m^2; FMI≥4.58 kg/m^2 in boys, FMI≥7.76 kg/m^2 in girls)

Dietary assessment

Dietary questionnaires included two non-consecutive 24 hour diet recalls and a semi-quantitative food-frequency questionnaire (FFQ) previously validated [18] and applied to other studies and surveys over the Spanish population [19-22]. 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. Edible fractions of foods were recorded in the database. The 145 foods items from the FFQ were collapsed to twenty-nine food groups, which may have practical importance in daily diet and clinical practice among Mediterranean youngers [23,24].

To avoid bias brought on by day-to-day intake variability, the questionnaires were administered homogeneously from Monday to Sunday. Well-trained dietitians administered the recalls and verified and quantified the food records.

To estimate volumes and portion sizes, the household measures found in the subjects' own homes were used. Conversion of food into nutrients was made using a computer program (ALIMENTA®, NUCOX, Palma, Spain) based on Spanish [25,26] and European [27] food composition tables and complemented with food composition data available for Majorcan food items [28]. Identification of misreporters: an energy intake:BMR ratio <0.92 (boys) and <0.85 (girls) was considered to represent underreporting [29], and an energy intake:BMR ratio ≥2.4 as overreporting [30,31]. Underreporters (20%) and overreporters (2%) were excluded from the analysis of dietary patterns.

Meal frequency

The meal frequency was calculated using data from the 24-hours diet recalls: breakfast (or the first eating occasion occurred after getting up), mid-morning snack, lunch, mid-afternoon snack, dinner, a meal before going to sleep, and others snacks. In the 24-hours diet recalls, to be considered as distinct, two consecutive food intakes had to occur either in a different place or after an interval of 1 hour if taken in the same place. The time interval was defined as the space of time elapsed between the last mouthful of the last food intake and the first mouthful of the following one. Any food or drink intake providing energy was also taken into account. Three groups of eating frequency were considered: ≤3, 4, and ≥5 times/day. According to Drummond *et al.* [32], eating occasions were also classified into two categories: as 'meals' (breakfast, lunch and dinner) and 'snacks' (morning and afternoon snacks, and others snacks).

Assessment of other co-variables

Sociodemographic and lifestyle variables

A questionnaire incorporating the following questions was used: age group; parental educational level (according to years at school and type of education: low, <6 years; medium, 6-12 years; high, >12 years); parental socio-economic level (based on the occupation of parents and classified as low, medium and high), according to the Spanish Society of Epidemiology)(32).

Physical activity patterns

Physical activity was evaluated according to the guidelines for data processing and analysis of the international physical activity questionnaire (IPAQ) [34] in the short form, and its specific modification for adolescents (IPAQ-A) [35]. The specific types of activity assessed were walking, moderate-intensity activities (i.e. physical activity at school), and vigorous-intensity activities (i.e. sport practice). According to the AVENA study [36], the questionnaire also included information on hours/day of TV viewing, computer use and video games, and typical sleep duration to the nearest 10 min. Physical inactivity was established with a cut-off level of 300 minutes of moderate/vigorous physical activity per week, in accordance with current guidelines of physical activity for adolescents [37,38].

Body image

Self-perceived body image was measured using the Stunkard scale [39], which consists of silhouette drawings ranging 1-9 with monotonic increments in overweight percentage where 1 is the leanest and 9 the heaviest. Separate figures for boys and girls were used. Participants were asked to identify of the 9 body figures: 'Which silhouette looks most like yourself?' and 'Which silhouette would you like to look like?' The difference between perceived body image and desired body image was used to determine the level of dissatisfaction with current body image. Values other than zero represent dissatisfaction with perceived body image. A positive value was indicative of the participant's desire to be smaller than his/her perceived current size, while a negative value reflected the participant's desire to be larger than his/her current perceived size [40,41]. Other questions such as to be worried about weight gain (no; a little; a lot) and encourage to lose weight (yes; no) were also considered.

Adherence to the Mediterranean Diet Pattern (MDP)

Adherence to the MDP was evaluated using the KIDMED index, described elsewhere [42], which are based on the principles of the MDP and summarises a score that ranges from 0 to 12. According to KIDMED scoring, individuals were categorised as ‘poor’ (≤3), ‘average’ (4-7) and ‘good’ (≥8) adherence to the MDP principles.

Statistics

Analyses were performed with Statistical Package for the Social Sciences version 19.0 (SPSS, Inc., Chicago, IL, USA). All tests were stratified by sex. Significant differences in prevalence were calculated by means of χ^2. Difference between groups’ means were tested using ANCOVA adjusted by their potential confounding factors (age, physical activity, parental educational level, parental socioeconomic status, media screen time, sleep time, overall & central adiposity and desire for weight change), and Bonferroni’s *post hoc* test were used to compare differences across groups. All correlations were investigated with Spearman’s rank correlation coefficient (*r*). Logistic regression models with the calculations of corresponding adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were used to examine possible differences between frequency consumption of several food groups and adherence to the MD and eating frequency, using a multivariate logistic regression after adjustment for potential confounding factors. The level of significance was established for *P* values <0.05.

Results

Participants’ characteristics according to eating frequency are showed in Table 1. Boys showed a significantly higher eating frequency than girls. About 22% of boys and 41% of girls showed an average of ≤3 occasions per day (≤2 eating occasions: 4.9% of boys, 15.1% of girls). Girls skip breakfast (36.4% *vs.* 21.5%; *P*<0.001), afternoon snack (67.2% *vs.* 55.7%; *P*<0.001) and dinner (14.1% *vs.* 3.6%; *P*<0.001) significantly more than boys. However, level of obesity was significantly higher in boys than girls (8.0% vs. 4.7%; *P*<0.05). To discriminate the effect of age, parental educational level, parental socioeconomic status, media screen time, physical activity, daily sleeping hours, overall & central adiposity and desire to change weight on eating frequency, all the analysis were adjusted for their potential confounders. Active adolescents and those who sleep more than 7 h/d and that desire to be thicker showed higher eating frequency.

In both sexes, BMI, WC, WHtR and FMI were inversely associated with eating frequency (Table 2). Additional logistic regression analysis showed that ≤3 eating occasions in both boys (OR: 4.56, 95%CI: 1.47-14.13; $P<0.01$) and girls (OR: 3.76; 95%CI: 1.03-13.79; $P<0.05$) increases the probability of being at risk of overall & central obesity.

The bivariate relationship (Spearman's correlation) between number of snacks (considering breakfast and snacks separately to lunch and dinner) and BMI (boys: r=-0.188, $P<0.01$; girls: r=-0.144, $P<0.01$), FMI (boys: r=-0.208, $P<0.01$; girls: r=-0.140, $P<0.01$) and WHtR (boys: r=-0.191, $P<0.01$; girls: r=-0.105, $P<0.05$) were inversely and significantly correlated.

In both sexes, the results revealed that the lowest BMI, FMI and WHtR and the highest average of eating occasions were observed in the highest tertile of energy intake (Figure 1). Moreover, negative correlations between the daily energy intake and BMI (boys: r=-0.057, $P\geq0.05$; girls: r=-0.158, $P<0.01$), FMI (boys: r=-0.159, $P<0.01$; girls: r=-0.155, $P<0.01$) and WHtR (boys: r=-0.175, $P<0.01$; girls: r=-0.149, $P<0.01$) were obtained. The average of eating occasions also was negatively correlated with BMI (boys: r=-0.199, $P<0.01$; girls: r=-0.197, $P<0.01$), FMI (boys: r=-0.210, $P<0.01$; girls: r=-0.173, $P<0.01$) and WHtR (boys: r=-0.199, $P<0.01$; girls: r=-0.187, $P<0.01$). The energy intake was positively associated with the average of eating occasions (boys: r=0.253, $P<0.01$; girls: r=0.210, $P<0.01$).

The energy intake was significantly greater in adolescents who had ≥5 eating occasions/day (Table 3). Lunch and dinner were the largest contributors of energy across the day: A third of energy was taken at lunch and dinner among adolescents who had 5 eating occasions/day, but half of energy was taken in these meals in adolescents who had ≤3 eating occasions/day. No significant differences between the intake of carbohydrates, fats and proteins (expressed as percentage of energy intake) in the three eating frequency groups were found in boys. The energy from carbohydrates was lower in girls who had ≤3 eating occasions/day, whereas the energy from fats and proteins were higher in them than in their counterparts. The lowest energy intake from carbohydrates in snacks was found in both boys and girls that had ≤3 eating occasions/day, and the lowest energy intake from carbohydrates in meals was found in girls that had ≤3 eating occasions/day. In both sexes, the fibre intake was significantly higher in adolescents that had ≥5 occasions per day, although no differences in fibre density were found.

Associations between the frequencies of consumption of various food groups, individual food items and the level of compliance with Mediterranean diet quality (KIDMED index) according to eating occasions/day (≤3 v. 4 v. ≥5) were also evaluated (Table 4). Compared with boys who reported ≤3 eating occasions/day, those with ≥5 occasions per day consumed more fresh fruits but also chocolates. Girls who reported ≥5 eating occasions/day consumed more milk and sausages than those with ≤3 eating occasions/day, while girls with 4 eating occasions/day showed the lowest consumption of pasta & rice dishes, high fat foods and chocolates. While no significant differences were found in girls, boys who ate at least 4 occasions per day had an overall quality diet higher than ≤3 eating occasions/day.

After applying multiple logistic regression analysis in order to control for various potential confounders (i.e. age, parental educational level, parental socio-economic status, body composition, media screen time, physical activity, sleep time and desire to change weight) and estimate the size of any observed differences, several differences with respect to the bivariate analysis were found. Specifically, boys who ate 4 occasions per day ate more frequently fresh fruits but less frequently pasta & rice dishes than the lowest eating frequency group. Boys who had ≥5 eating occasions/day showed higher consumption of poultry and fresh fruits; but lower consumption of red meat and vegetables than the lowest eating frequency group. In girls, 4 eating occasions/day were associated with high frequency consumption of poultry and sausages; but low frequency of red meat, other oils & fats and high fat foods than the lowest eating frequency category. Girls who had ≥5 eating occasions/day showed higher consumption of milk and nuts, but lower consumption of fruit juices than the lowest eating frequency. It should also be noted who no differences emerged with regard to the consumption of yogurt & cheese, fish & seafood, legumes, eggs, bread, breakfast cereals, biscuits, potatoes & tubercles and olive oil, but also dairy desserts, pizza, canned fruits, soft drinks, tea & coffee, alcoholic beverages, sweets and chocolates.

The best adherence to the Mediterranean diet was observed in boys who had ≥4 eating occasions/day and girls who had 4 eating occasions/day. Table 5 presents results examining the KIDMED index test. Comparing to boys who had ≤3 eating occasions/day, a higher percentage of boys who ate ≥4 times/day reported breakfast daily, intake of fruits daily and of two yogurts and/or 40g cheese. The lowest percentage of boys who reported to visit fast-food restaurants weekly and to consume sweets and candy several times/day was observed in the 4 eating occasions/day group. Girls who had ≥4 eating occasions/day were more likely to breakfast daily, to consume breakfast cereals and a dairy product for breakfast, as well as to consume fish regularly and two yogurts and/or 40g cheese daily than in those girls who had ≤3 eating occasions/day. However, the highest percentage of adolescents who reported to consume commercially baked foods or pastries for breakfast was found in the ≥5 eating occasions/day group.

Discussion

Due to the increased prevalence of overweight and obesity among youth and the risk of subsequent chronic disease in adulthood, it is important to determine the correlates of risk for overweight and obesity in youth [43]. Previous studies in children, adolescents and adults have also found an inverse relationship between eating frequency and BMI [3,5,44-48]. Our study is confirmatory of these previous results, and adds new data on the association between eating frequency and overall (FMI) and central (WHtR) adiposity; being the risk of central & overall adiposity especially high among those adolescents who had an average of ≤3 eating occasions/day compared to those who had ≥5 eating occasions/day. Therefore, it is not surprising that higher percentages of low eating occasions' practitioners were registered among overweight and obese adolescents, as well as it is also not surprising that adolescents physically inactive, sleep less than 7 h/d, and like to be thinner are those that showed the lowest number of eating occasions/day.

These associations occur even though the lowest energy intake was observed in adolescents that showed the lowest number of eating occasions throughout the day.

The present study also supports that adolescents may benefit if they eat more frequently, distributing their energy intake more evenly throughout the day [48]. Thus, frequent intake occasions with a small contribution of the main meals to total daily energy intake is associated with a small risk of overall and central obesity. Therefore, snacking frequency may have positive advantages to the energy intake distribution among all meals. Programs to prevent and reduce obesity should promote at least 5 daily eating occasions.

However, an individual analysis of nutrients and food may ignore important interactions between components of the diet, should be interesting to study the dietary patterns of a population. Thus, the association between eating occasions and frequency consumption of several food groups and diet quality by compliance with the Mediterranean diet were also assessed. In the present study, 4 eating occasions/day in girls and 4 or more eating occasions/day in boys were associated with higher probability of an optimal quality diet. Boys that had ≤3 eating occasions/day showed lower diet quality than those boys that had ≥4 eating occasions/day which were more likely to breakfast daily and to report daily consumption of fruits and yogurt & cheese. Girls that ate ≥4 eating occasions/day were also more likely to breakfast daily and to consume dairy products for breakfast. However, while girls that had 4 eating occasions/day reported higher breakfast cereals intake and lower consumption of other oils & fats and high fat foods than those girls classified in the lowest group, girls that ate ≥5 occasions per day were more likely to consume commercially baked foods or pastries for breakfast than girls eating ≤3 occasions per day. Previously we also reported that ≥5 occasions per day may promote high daily consumption of energy-dense foods and drinks in girls [49]. In the literature, it has been reported that snacks are usually carbohydrate rich foods [32,50,51], and previous studies in adults found that men and women usually choose beverages (coffee, cola and milk), ice cream and fruits as snacks foods; being the mean daily carbohydrate intake positively correlated with eating frequency [52].

Limitations of the study

The present study was a cross-sectional analysis, and longitudinal studies are needed to confirm these findings.

The 24-hour diet recalls provides information on food intake, and because the data collection occurs after consumption, this method does not affect an individual's food choices on a given day [53]. At least two non-consecutive administrations are necessary to assess usual intakes, to reduce dependency on intake from the previous day and by household food availability [53]. Accordingly, we applied two 24-hour non-consecutive recalls in this study.

Although 24-hour diet recalls collects data soon after intake, recalls have also limitations related to memory and bias [53]. Many adolescents have difficult to estimate their consumption of some foods, and the consequence of difficulties in assessing high energy-dense foods may be that consumed amounts are underestimated, which in turn may have a great effect on the validity of the reported energy intake [54]. Under-reporting and over-reporting are significant contributors to the systematic bias of self-reported dietary assessments, increasing or decreasing estimates of the incidence of inadequate intake, and distorting the relationships between nutrient intake and health. Therefore, there are real shortcomings in dietary studies.

To solve these shortcomings, it has been pointed out [55] that dietary studies should include an internal validation procedure. Biomarkers of energy intake have been suggested to play a useful role in dietary assessment, especially for components of foods that are highly variable within different samples of the same food. However, biomarkers, even when available, also have many limitations [56]. Advantages and limitations of each must be carefully considered in any specific application, but the mainstay of nutritional epidemiology will remain assessments of dietary intake.

Adherence to a Mediterranean dietary pattern was evaluated through the use of the KIDMED index. Although the MD indices have a number of limitations and problems in their use, grouping foods to obtain scores is a very useful method to evaluate overall diet [57,58]. The validity of the KIDMED index has not been determined compared with other measures of dietary patterns such as FFQ [58]. However, a high KIDMED score was positively associated with healthy foods and this finding may provide some support for the validity of the index [58].

Dietary and physical activity data were based on self-reports [59]. Literature reports that food underreporting is usually associated with gender and weight status [60,61]. Self-report of physical activity also can lead to overreport the physical activity due to a social desirability bias, and therefore the number of inactive individuals may be greater than that reported [62,63], especially among children and adolescents, and also among obese [63]. However, in many cases, self-reporting is the only feasible method of assessing physical activity [64] and dietary intake in epidemiological studies. Although epidemiologists made every effort to get as accurate data as possible, there is a possibility that misreporting occurred [24].

Conclusions

To sum up, this study shows that increased meal frequency may have a beneficial effect on reducing overall and central adiposity. Moreover, the present results also provide valuable information regarding eating occasion frequency and the diet-quality. Overall, 4 eating occasions/day in girls and 4 or more eating occasions/day in boys were associated with higher probability of an optimal quality diet. Therefore, promotion of at least 5 daily meals and snacks should be considered in nutrition education programs for adolescents aimed at reducing risk of disease. However, education programs could focus on strategies to promote healthy food choices following the Mediterranean diet.

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analysed the data and wrote the manuscript. AP and JAT supervised the study. AP and JAT obtained funding. *Conflict of interests*. The authors state that there are no conflicts of interest.

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Table 1. Characteristics of the study population

	Number of daily meals			*P*
	≤3	4	≥5	
n	309	322	325	
Sex				
Boys	21.9	35.5	42.6	0.000
Girls	40.8	32.3	26.9	
Age group				
12-13 years old	33.5	27.7	38.8	0.179
14-15 years old	31.0	35.7	33.3	
16-17 years old	34.3	35.2	30.5	
Parental educational level				
Low	31.2	35.7	33.1	0.885
Medium	31.5	34.6	33.9	
High	33.9	32.0	34.2	
Parental socioeconomic status				
Low	31.3	33.8	34.9	0.779
Medium	31.1	35.0	33.8	
High	34.5	29.9	35.6	
Media screen time				
<2 /d	29.6	39.0	31.4	0.642
≥2-<4 h/d	33.5	31.9	34.6	
≥4 h/d	32.1	34.2	33.7	
Sleep time				
<7 h/d	50.0	25.7	24.3	0.004
≥7 h/d	31.0	34.3	34.7	
Physical activity				
Inactive	37.1	33.2	29.7	0.027
Active	29.1	34.5	36.4	
Desire to change weight				
To be thinner	46.4	32.8	20.8	0.000
To remain the same weight	25.3	36.0	38.7	
To be thicker	16.2	32.3	51.5	

Significant differences between boys and girls by χ^2. Only people who did not mis-report their energy intake were considered for this analysis.

Table 2. Anthropometric indices across categories of eating frequency

		Number of daily meals			*P*
		≤3	4	≥5	
Boys	*n*	93	151	182	
	%	21.9	35.5	42.6	
	BMI (kg/m^2)†	22.0 ± 2.9^{c}	21.5 ± 2.9^{b}	20.5 ± 2.9^{b,c}	0.001
	BMI≥25-<30 kg/m^2 (%)‡	28.6	19.4	8.9	0.000
	BMI≥30 kg/m^2 (%)‡	7.1	4.2	1.2	0.047
	WC (cm)†	73.4 ± 6.7^{c}	72.0± 6.7	70.5± 6.7^{c}	0.007
	HC (cm)†	91.8 ± 7.4	91.0 ± 7.4	90.1 ± 7.4	0.236
	WHtR†^{a}	0.44 ± 0.04^{c}	0.43 ± 0.04^{b}	0.41 ± 0.04^{b,c}	0.000
	WHtR≥0.5 (%)‡	11.9	7.6	1.2	0.001
	FMI (kg/m^2)†	4.6 ± 2.0^{a,c}	3.7 ± 2.1^{a,b}	2.9 ± 2.0^{b,c}	0.000
	FMI≥4.58 kg/m^2 (%)‡	41.7	23.6	9.5	0.000
	Body composition				
	Not at risk (%)‡	54.8	70.8	88.1	0.000
	Overweight/obesity (%)‡	45.2	29.2	11.9	0.000
Girls	*n*	216	171	143	
	%	40.8	32.3	26.9	
	BMI (kg/m^2)†	22.3 ± 3.2^{a,c}	21.4 ± 3.2^{a}	20.6 ± 3.2^{c}	0.000
	BMI≥25-<30 kg/m^2 (%)‡	16.5	13.9	9.0	0.140
	BMI≥30 kg/m^2 (%)‡	5.8	1.8	3.0	0.113
	WC (cm)†	68.4 ± 6.6^{a,c}	66.6 ± 6.5^{a}	65.3 ± 6.5^{c}	0.000
	HC (cm)†	95.0 ± 8.6^{c}	93.8 ± 8.5^{b}	91.08.5^{b,c}	0.000
	WHtR†^{a}	0.43 ± 0.04^{a,c}	0.41 ± 0.04^{a}	0.41 ± 0.04^{c}	0.000
	WHtR≥0.5 (%)‡	7.3	4.9	3.7	0.339
	FMI (kg/m^2)†	5.6 ± 3.1^{c}	5.1 ± 2.2	4.6± 1.9^{c}	0.000
	FMI≥7.76 kg/m^2 (%)‡	13.7	6.7	5.2	0.013
	Body composition				
	Not at risk (%)‡	78.0	84.1	88.1	0.049
	Overweight/obesity (%)‡	22.0	15.9	11.9	0.049

Abbreviations: BMI, body mass index; WC, waist circumference; HC, hip circumference; WHtR, waist-to-height ratio; FMI, fat mass index. Only people who did not misreport their energy intake were considered for this analysis.
Data are expressed as mean (95% CI), %. Significant differences groups by †χ^2 and by ‡ANCOVA after adjusted by age, parental educational, parental socioeconomic status, media screen time, physical activity, sleep time and desire to change weight. Significant difference by Bonferroni's *post-hoc* test (p<0.05): ^{a}≤3 *vs* 4, ^{b}4 *vs* ≥5, ^{c}≤3 *vs* ≥5.

Table 3. Dietary intake according to eating frequency

		n	Number of daily meals ≤3	4	≥5	*P*
Boys	*n*		35	135	256	
	EI (kcal/day)	426	2185 ± 605.3[c]	2254.8 ± 601.8[b]	2714.8 ± 598.8[b,c]	0.000
	Energy intake (% total)					
	Breakfast†	393	20.8 ± 7.1[c]	16.9 ± 7.1[b]	12.3 ± 7.1[b,c]	0.000
	Morning snack†	317	22.3 ± 7.8	23.4 ± 7.7[b]	17.9 ± 7.6[b]	0.000
	Lunch†	423	49.4 ± 10.9[a,c]	32.6 ± 10.8[a,b]	27.0 ± 10.8[b,c]	0.000
	Afternoon snack†	324	19.3 ± 8.9	17.7 ± 8.8	14.7 ± 8.7	0.045
	Dinner†	417	33.5 ± 9.7[a,c]	28.5 ± 9.6[a,b]	25.1 ± 9.6[b,c]	0.000
	Others snacks†	109	0.98 ± 9.4	14.9 ± 9.4	10.7 ± 9.2	0.243
	Carbohydrate (% energy)	426	43.6 ± 7.9	44.3 ± 7.9	45.3 ± 7.8	0.392
	Meals‡	426	43.4 ± 9.6	43.1 ± 9.5	43.3 ± 9.5	0.978
	Snacks‡	426	18.0 ± 15.2[a,c]	51.2 ± 15.1[a]	51.2 ± 15.0[c]	0.000
	Fat (% energy)	426	39.2 ± 7.1	38.3 ± 7.0	38.3 ± 7.0	0.825
	SFA (% energy)	426	13.6 ± 3.6	13.7 ± 3.6	13.7 ± 3.6	0.985
	Protein (% energy)	426	17.2 ± 4.0	17.2 ± 4.0	16.4 ± 4.0	0.166
	Fibre (g/day)	426	13.6 ± 6.4[c]	14.3 ± 6.4[b]	17.0 ± 6.3[b,c]	0.000
	Fibre density (g/MJ)	426	1.5 ± 0.6	1.7 ± 0.6	1.6 ± 0.6	0.517
Girls	*n*		65	207	258	
	EI (kcal/day)	530	1704.7 ± 502.0[c]	1906.1 ± 503.1[b]	2220.1 ± 502.3[b,c]	0.000
	Energy intake (% total)					
	Breakfast†	455	19.6 ± 6.7[c]	16.4 ± 6.8[b]	11.5 ± 6.8[b,c]	0.000
	Morning snack†	360	26.3 ± 8.3[c]	22.9 ± 8.1[b]	19.7 ± 8.1[b,c]	0.001
	Lunch†	530	45.2 ± 11.2[a,c]	35.6 ± 11.2[a,b]	28.8 ± 11.2[b,c]	0.000
	Afternoon snack†	390	21.2 ± 9.6	17.4 ± 9.8[b]	14.9 ± 9.6[b]	0.019
	Dinner†	516	34.2 ± 10.8[a,c]	26.6 ± 10.8[a,b]	22.7 ± 10.8[b,c]	0.000
	Others snacks†	109	-	13.4 ± 8.5	10.4 ± 8.0	0.361
	Carbohydrate (% energy)	530	40.4 ± 8.6[a,c]	44.0 ± 8.6[a]	45.5 ± 8.6[c]	0.001
	Meals‡	530	38.8 ± 11.0[c]	42.7 ± 11.0	43.6 ± 11.0[c]	0.019
	Snacks‡	530	20.2 ± 16.4[a,c]	53.5 ± 16.5[a]	51.4 ± 16.5[c]	0.000
	Fat (% energy)	530	42.0 ± 7.6[a,c]	39.1 ± 7.6[a]	38.5 ± 7.6[c]	0.012
	SFA (% energy)	530	13.8 ± 3.8	13.4 ± 3.8	13.4 ± 3.8	0.778
	Protein (% energy)	530	17.7 ± 4.3[c]	16.9 ± 4.3	16.0 ± 4.3[c]	0.014
	Fibre (g/day)	530	10.8 ± 5.8[a,b]	13.0 ± 5.8[a,c]	15.3 ± 5.8[b,c]	0.000
	Fibre density (g/MJ)	530	1.6 ± 0.7	1.8 ± 0.7	1.8 ± 0.7	0.442

Abbreviations: EI, energy intake; SFA, saturated fatty acids.
Only people who did not mis-report their energy intake were considered for this analysis.
Data are expressed as mean ± SEM. Statistical analysis and significant differences between group means were performed by ANCOVA after adjusted by age, parental educational, parental socioeconomic status, body composition, media screen time, physical activity, sleep time and desire to change weight.
Significant difference by Bonferroni's *post-hoc* test (p<0.05): [a]≤3 *vs* 4, [b]4 *vs* ≥5, [c]≤3 *vs* ≥5.
†Percentage of consumers.
‡Meals: breakfast, lunch, and dinner; snacks: morning, afternoon, and other snacks).

Table 4. Food consumption and adherence to the Mediterranean diet by eating frequency categories.

		Boys						**Girls**					
Food groups	**Frequency categories**	**≤3 (%)**	**4 (%)**	**≥5 (%)**	***P*†**	**4 *v.* ≤3 OR (95% CI)‡**	**≥5 *v.* ≤3 OR (95% CI)‡**	**≤3 (%)**	**4 (%)**	**≥5 (%)**	***P*†**	**4 *v.* ≤3 OR (95% CI)‡**	**≥5 *v.* ≤3 OR (95% CI)‡**
Dairy products													
Milk†	≥7 t/w v. <7 t/w (ref.)	74.4	81.7	79.5	0.419	0.75 (0.27-2.07)	0.73 (0.27-1.99)	55.9	67.9	78.4	0.000	1.60 (0.87-2.96)	3.53 (1.66-7.50)**
Yogurt & cheese	≥7 t/w v. <7 t/w (ref.)	60.5	70.4	69.3	0.366	1.33 (0.55-3.23)	1.42 (0.59-3.41)	60.7	57.6	70.1	0.071	0.81 (0.45-1.48)	1.42 (0.68-2.98)
Dairy desserts	≥2 t/w v. 2 t/w (ref.)	70.9	78.2	78.3	0.366	1.20 (0.48-3.00)	0.92 (0.33-2.56)	60.7	64.2	67.9	0.400	0.98 (0.52-1.83)	0.85 (0.41-1.75)
Meat													
Red meat†	≥2 t/w v. 2 t/w (ref.)	57.6	49.3	58.8	0.216	0.40 (0.15-1.04)	0.32 (0.12-0.85)*	47.2	38.2	47.0	0.165	0.56 (0.31-1.02)	0.68 (0.34-1.38)
Poultry & rabbit†	≥2 t/w v. 2 t/w (ref.)	9.3	14.1	18.7	0.132	3.46 (0.82-14.66)	16.45 (2.55-105.94)**	13.6	15.8	17.2	0.654	2.67 (1.11-6.42)*	1.33 (0.50-3.52)
Sausages†	≥5 t/w v. ≤4 t/m (ref.)	49.4	47.2	59.4	0.079	0.80 (0.27-2.35)	0.94 (0.29-2.97)	41.7	46.7	58.2	0.012	2.04 (1.00-4.14)*	2.06 (0.95-4.49)
	2-4 t/w v. ≤4 t/m (ref.)	27.1	29.6	25.5	0.720	1.11 (0.38-3.24)	1.11 (0.35-3.59)	25.1	26.1	22.4	0.752	1.43 (0.65-3.12)	1.58 (0.65-3.84)
	≤4 t/m (ref.)	23.5	23.2	15.2	0.133			33.2	27.3	19.4	0.022		
Fish & seafood†	≥2 t/w v. 2 t/w (ref.)	17.6	21.1	18.8	0.788	0.73 (0.24-2.20)	0.44 (0.13-1.56)	14.1	13.9	16.4	0.797	0.92 (0.40-2.09)	1.02 (0.42-2.48)
Eggs†	≥2 t/w v. 2 t/w (ref.)	29.4	33.8	39.4	0.267	1.14 (0.43-3.01)	1.69 (0.67-4.30)	23.1	18.8	28.4	0.149	1.09 (0.53-2.25)	1.26 (0.58-2.73)
Legumes	≥2 t/w v. 2 t/w (ref.)	16.3	21.1	19.9	0.663	0.94 (0.29-2.99)	1.75 (0.48-6.42)	17.8	17.6	14.9	0.762	1.14 (0.54-2.40)	0.73 (0.30-1.78)
Cereals, grains & products													
Bread†	≥7 t/w v. <7 t/w (ref.)	81.4	85.2	86.7	0.527	1.25 (0.37-4.17)	0.61 (0.19-2.00)	78.7	84.8	85.8	0.159	1.64 (0.74-3.62)	1.03 (0.42-2.57)
Breakfast cereals†	≥5 t/w v. <5 t/w (ref.)	38.4	54.2	51.8	0.053	2.01 (0.84-4.81)	2.27 (0.91-5.71)	25.2	33.9	35.8	0.072	1.74 (0.92-3.30)	1.64 (0.79-3.41)
Biscuits	≥5 t/w v. <5 t/w (ref.)	18.6	22.5	25.3	0.484	1.94 (0.83-4.49)	2.39 (0.99-5.77)	17.3	23.0	28.4	0.055	1.41 (0.77-2.57)	1.01 (0.52-1.96)
Pasta & rice dishes	≥5 t/w v. <5 t/w (ref.)	24.4	15.5	24.1	0.126	0.26 (0.09-0.74)*	0.48 (0.17-1.33)	22.3	9.7	17.9	0.006	0.38 (0.15-0.97)*	0.71 (0.29-1.79)
Pizza†	≥2 t/w v. 2 t/w (ref.)	18.6	15.5	16.3	0.824	0.43 (0.14-1.35)	0.56 (0.18-1.71)	13.9	9.1	11.9	0.369	0.75 (0.28-2.01)	0.86 (0.31-2.37)
Fruits													
Fresh fruits†	≥2/day v. 2/day (ref.)	19.8	35.2	32.5	0.040	2.93 (1.08-7.97)*	3.73 (1.21-11.51)*	30.2	27.3	37.3	0.164	0.64 (0.31-1.31)	1.82 (0.87-3.83)
Fruit juices	≥7 t/w v. <7 t/w (ref.)	43.0	55.6	56.0	0.109	1.23 (0.51-3.01)	0.99 (0.39-2.48)	55.4	49.7	46.3	0.234	0.78 (0.43-1.42)	0.36 (0.18-0.72)**
Canned fruits	≥2 t/w v. <2 t/w (ref.)	9.3	9.2	9.6	0.989	0.73 (0.18-2.89)	0.90 (0.21-3.82)	5.9	4.8	3.7	0.657	0.62 (0.16-2.47)	0.44 (0.10-1.84)
Vegetables†	≥2/day v. <2/day (ref.)	5.8	5.6	8.4	0.570	1.20 (0.22-6.53)	0.12 (0.02-0.78)*	14.9	12.1	11.2	0.573	0.84 (0.34-2.05)	0.66 (0.24-1.82)
Nuts†	≥2 t/w v. 2 t/w (ref.)	37.2	37.3	39.8	0.883	0.91 (0.38-2.15)	0.96 (0.38-2.43)	20.8	23.6	32.1	0.058	1.91 (0.94-3.88)	2.36 (1.13-4.91)*
Potatoes & tubercles†	≥2 t/w v. 2 t/w (ref.)	44.2	40.1	45.2	0.657	0.84 (0.35-2.05)	0.82 (0.32-2.09)	32.2	32.7	40.3	0.259	1.71 (0.41-1.37)	1.49 (0.73-3.04)
Fats													
Olive oil	≥7 t/w v. <7 t/w (ref.)	40.0	48.6	53.9	0.112	1.43 (0.62-3.30)	1.81 (0.72-4.57)	54.8	49.1	58.2	0.273	0.75 (0.41-1.37)	0.97 (0.49-1.91)
Others oils & fats	≥2 t/w v. <2 t/w (ref.)	41.2	33.8	41.2	0.351	0.48 (0.19-1.25)	0.52 (0.20-1.33)	39.2	29.1	40.3	0.069	0.48 (0.25-0.90)*	0.66 (0.33-1.34)
High fat foods	≥5 t/w v. ≤4 t/m (ref.)	41.2	42.3	52.7	0.102	0.83 (0.30-2.32)	1.05 (0.37-2.99)	41.2	26.8	44.0	0.003	0.31 (0.14-0.72)**	0.62 (0.26-1.50)
	2-4 t/w v. ≤4 t/m (ref.)	31.8	26.1	24.8	0.489	1.57 (0.55-4.53)	1.32 (0.42-4.18)	27.6	36.0	21.6	0.022	1.24 (0.59-2.61)	0.77 (0.32-1.88)
	≤4 t/m (ref.)	27.1	31.7	22.4	0.188			31.2	37.2	34.3	0.480		

Table 4. *Continued*

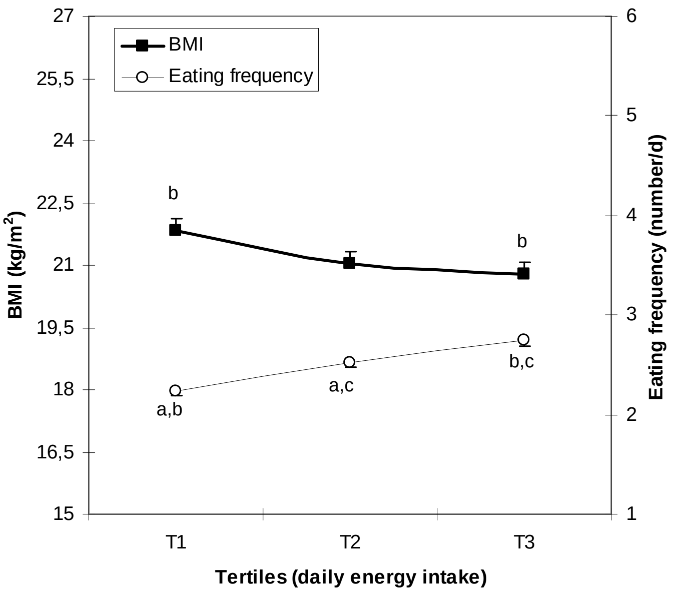
Food groups	Frequency categories	Boys ≤3 (%)	Boys 4 (%)	Boys ≥5 (%)	Boys *P*†	Boys 4 *v.* ≤3 OR (95% CI)‡	Boys ≥5 *v.* ≤3 OR (95% CI)‡	Girls ≤3 (%)	Girls 4 (%)	Girls ≥5 (%)	Girls *P*†	Girls 4 *v.* ≤3 OR (95% CI)‡	Girls ≥5 *v.* ≤3 OR (95% CI)‡
Drinks													
Soft drinks	≥5 t/w v. ≤4 t/m (ref.)	49.4	54.2	62.4	0.111	1.09 (0.41-2.91)	1.92 (0.71-5.22)	47.0	36.0	43.3	0.105	0.63 (0.34-1.19)	1.05 (0.48-2.28)
	2-4 t/w v. ≤4 t/m (ref.)	9.4	15.5	9.1	0.171	1.96 (0.49-7.84)	0.68 (0.16-2.94)	9.1	12.8	10.4	0.520	1.51 (0.54-4.19)	1.98 (0.60-6.49)
	≤4 t/m (ref.)	41.2	30.2	28.5	0.109			43.9	51.2	46.3	0.378		
Tea & coffee	≥2 t/w v. 2 t/w (ref.)	16.5	10.6	12.7	0.434	0.73 (0.19-2.89)	0.88 (0.23-3.35)	20.7	15.9	13.5	0.204	1.09 (0.51-2.31)	0.55 (0.21-1.41)
Alcoholic drinks	≥1 t/w v. <1 t/w (ref.)	9.2	6.3	10.8	0.378	0.64 (0.12-3.32)	1.48 (0.30-7.28)	5.0	3.0	2.2	0.366	0.94 (0.17-5.37)	1.41 (0.19-10.78)
Other groupings													
Sweets	≥5 t/w v. ≤4 t/m (ref.)	74.1	70.4	75.8	0.566	3.29 (0.85-12.68)	1.04 (0.30-3.62)	78.8	79.1	76.1	0.793	2.53 (0.96-6.62)	2.64 (0.73-9.50)
	2-4 t/w v. ≤4 t/m (ref.)	10.6	18.3	10.9	0.112	3.80 (0.85-17.04)	1.28 (0.27-6.05)	10.6	12.9	17.9	0.155	2.15 (0.67-6.89)	3.14 (0.76-13.01)
	≤4 t/m (ref.)	15.3	11.3	13.3	0.674			10.6	8.0	6.0	0.318		
Chocolates	≥5 t/w v. ≤4 t/m (ref.)	14.1	17.6	27.3	0.025	1.07 (0.30-3.75)	1.84 (0.59-5.69)	17.7	12.8	27.6	0.004	0.94 (0.40-2.24)	2.14 (0.93-4.93)
	2-4 t/w v. ≤4 t/m (ref.)	12.9	12.7	9.7	0.639	0.83 (0.23-2.95)	1.04 (0.31-3.56)	9.1	12.8	14.2	0.317	1.94 (0.76-4.91)	1.44 (0.51-4.07)
	≤4 t/m (ref.)	72.9	69.7	63.0	0.226			73.2	74.4	58.2	0.004		
KIDMED index scores													
Low quality diet (0-3)		20.0	8.2	7.6	0.005	1.00 (ref.)	1.00 (ref.)	22.8	13.7	16.4	0.068	1.00 (ref.)	1.00 (ref.)
Mid-quality diet (4-7)		57.6	52.1	59.6	0.385	2.83 (1.07-7.47)*	5.92 (2.06-17.02)**	56.4	55.3	56.7	0.964	2.20 (1.05-4.58)*	1.23 (0.60-2.54)
Optimal quality diet (8-12)		22.4	39.7	32.7	0.025	5.17 (1.81-14.80)**	4.89 (1.57-15.28)**	20.8	31.1	26.9	0.080	3.61 (1.58-8.27)**	1.28 (0.54-3.03)

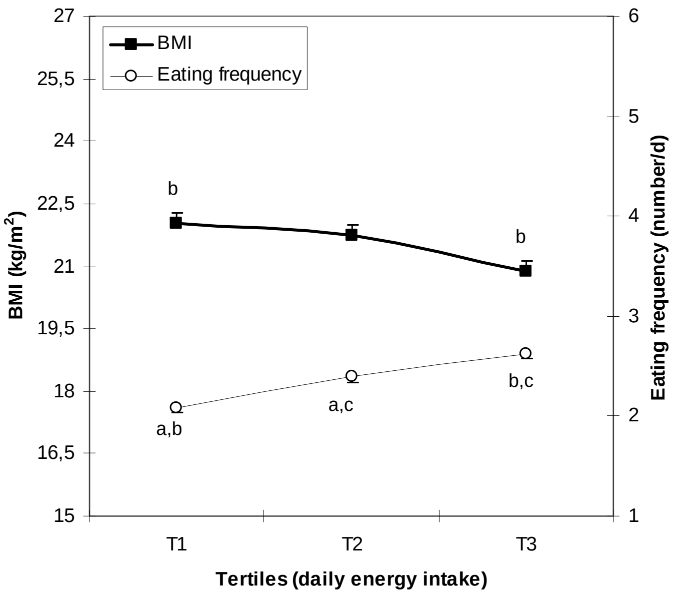
Abbreviations: OR, odds ratio; CI, confidence interval; ref.: reference.
†Significant differences between eating frequencies by χ^2 test.
‡Multivariate analysis (multiple logistic regression analysis considering the simultaneous effect of all explanatory variables) adjusted by age, parental educational level, parental socioeconomic status, overall & central adiposity, media screen time, physical activity, sleep hours, and desire to change weight. Significant differences: **P*<0.05; ***P*<0.01; ****P*<0.001.
Only adolescents who did not misreport their energy intake were considered for this analysis.

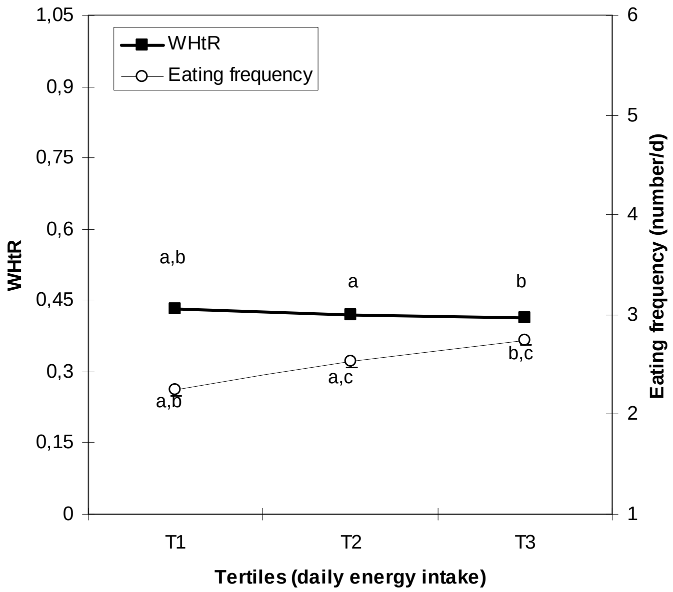
Table 5. Compliance with Mediterranean Diet Quality Index (KIDMED) by sex and eating frequency

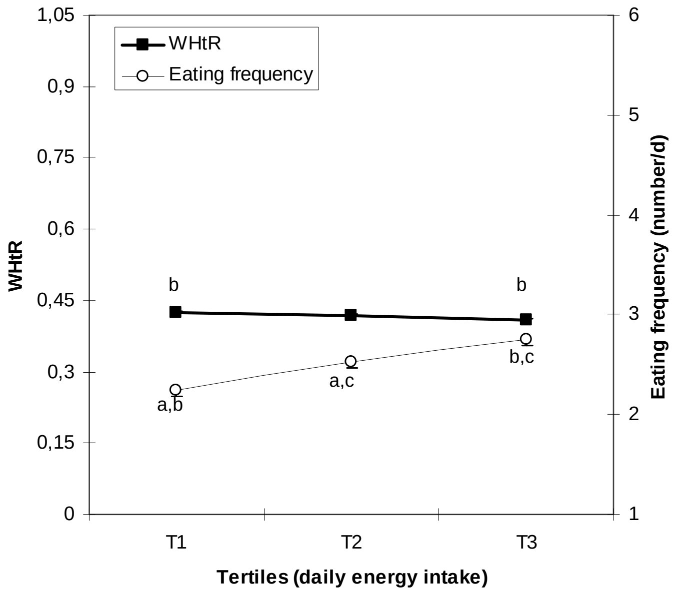
	Boys (%)				Girls (%)			
KIDMED test	**≤3 (%)**	**4 (%)**	**≥5 (%)**	***P***	**≤3 (%)**	**4 (%)**	**≥5 (%)**	***P***
Fruit or fruit juice daily	78.4	89.0	90.1	0.020	77.3	84.7	82.1	0.193
Second serving of fruit daily	34.1	55.5	49.4	0.006	48.8	47.2	52.2	0.684
Fresh or cooked vegetables daily	51.7	58.2	56.4	0.622	66.5	64.4	64.9	0.908
Fresh or cooked vegetables >1/d	27.3	30.8	32.6	0.683	28.1	31.9	28.4	0.693
Regular fish consumption (at least 2-3/week)	52.3	51.4	55.2	0.774	43.3	56.4	55.2	0.022
Fast-food (hamburger) restaurant >1/week	21.6	11.0	23.8	0.010	18.7	13.5	17.2	0.402
Legumes >1/week	46.6	58.2	55.8	0.207	53.7	55.2	51.5	0.814
Pasta or rice almost daily (≥5/week)	58.6	51.4	59.3	0.323	49.8	46.3	41.0	0.292
Cereal or cereal product for breakfast	69.3	70.5	73.8	0.695	53.2	68.7	63.4	0.008
Regular nut consumption (at least 2-3/week)	48.9	47.9	52.9	0.649	33.0	35.0	44.8	0.076
Use of oil olive at home	87.4	87.0	89.5	0.757	91.1	91.4	86.6	0.310
No breakfast	28.4	17.1	11.1	0.002	44.3	18.4	14.2	0.000
Dairy product for breakfast	77.3	79.5	82.6	0.568	56.2	71.2	77.6	0.000
Commercially baked foods or pastries for breakfast	30.7	30.8	42.4	0.053	24.1	30.7	36.6	0.047
Two yogurts and/or 40 g cheese daily	50.0	62.3	66.3	0.037	48.8	52.8	63.4	0.028
Sweets and candy several times a day	31.8	19.9	35.5	0.008	33.5	30.1	39.6	0.224

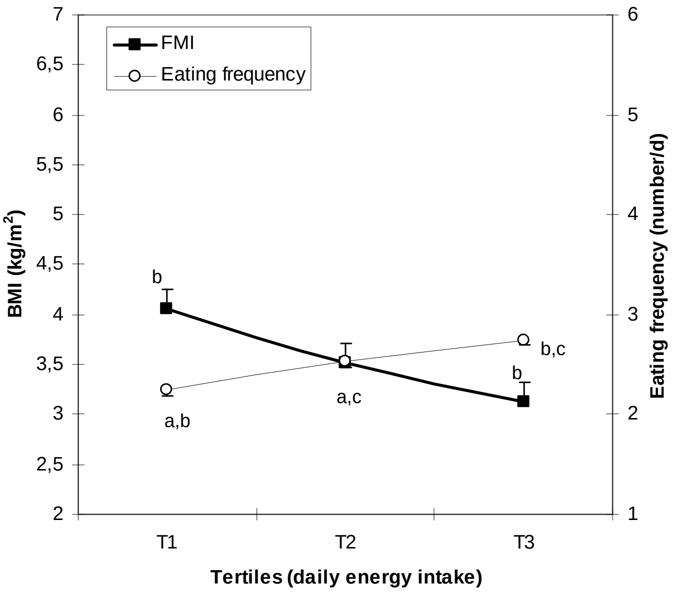
Significant differences between gender by χ^2 test.
Only adolescents who did not misreport their energy intake were considered for this analysis.


BMI
Eating frequency
BMI (kg/m2)
Eating frequency (number/d)
Tertiles (daily energy intake)
T1
T2
T3
b
a,b
a,c
b
b,c


BMI
Eating frequency
BMI (kg/m2)
Eating frequency (number/d)
Tertiles (daily energy intake)
T1
T2
T3
b
a,b
a,c
b
b,c


WHtR
Eating frequency
WHtR
Eating frequency (number/d)
Tertiles (daily energy intake)
T1
T2
T3
a,b
a
b
a,b
a,c
b,c


WHtR
Eating frequency
WHtR
Eating frequency (number/d)
Tertiles (daily energy intake)
T1
T2
T3
b
b
a,b
a,c
b,c


FMI
Eating frequency
BMI (kg/m2)
Eating frequency (number/d)
Tertiles (daily energy intake)
T1
T2
T3
b
a,b
a,c
b
b,c

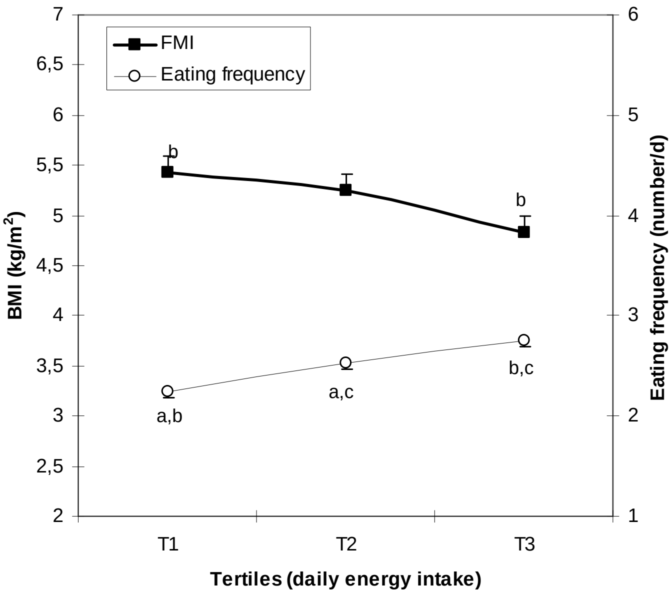

FMI
Eating frequency
BMI (kg/m2)
Eating frequency (number/d)
Tertiles (daily energy intake)
T1
T2
T3
b
a,b
a,c
b
b,c

Figure legend

Figure 1. BMI (A: boys; B: girls), BF (C: boys; D: girls) and WHtR (E: boys; F: girls) and eating frequency (mean values ± SEM) according to tertiles of daily energy intake: T1 (boys: <8.86 MJ/d; girls: <7.38 MJ/d), T2 (boys: ≥8.86-<11.46 MJ/d; girls: ≥7.38-<9.31 MJ/d), and T3 (boys: ≥11.46 MJ/d; girls: ≥9.31 MJ/d). Only people who did not misreport their EI were considered for this analysis. Analysis was adjusted by age, parental educational level, parental socioeconomic status, media screen time, physical activity, sleep time and desire to change weight. Significant differences by ANCOVA and Bonferroni's *pos-hoc* test (p<0.01): [a]T1 *vs* T2, [b]T2 *vs* T3, [c]T1 *vs* T3.

Manuscrit V

Defining body fatness in adolescents: IOTF reference, WHO standard or using different anthropometric indicators? A proposal of the AFAD-A classification.

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Defining body fatness in adolescents: IOTF reference, WHO standard or using different anthropometric indicators? A proposal of the AFAD-A classification

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Abstract

Aims: To compare the prevalence of overweight and obesity using the IOTF and the WHO-2007 references and interpret body composition by comparing measures of body weight (BMI) and body fatness (fat mass index, FMI; and waist-to-height ratio, WHtR) among the adolescent population of the Balearic Islands.

Methods and Results: A random sample (*n*=1231) of the adolescent population (12-17 years old) was interviewed in the Balearic Islands (2007-2008). Weight, height, waist circumference, triceps and subscapular skinfolds were used to calculate body mass index (BMI), fat mass index (FMI) and waist-to-height ratio (WHtR). The prevalence of overweight and obesity were 12.3% and 15.4% using WHO standards and 18.6% and 6.1% using IOTF definition. Despite that IOTF cut-offs misclassified less often than WHO standards, BMI categories were combined with FMI and WHtR resulting the Adiposity & Fat Distribution for adolescents (AFAD-A) classification. The AFAD-A classification identified the following groups depending if adolescents were normal-fat or overfat: normal-weight normal-fat (73.2%), normal-weight overfat (2.1%), overweight normal-fat (6.7%), overweight overfat (11.9%) and obesity (6.1%). Moreover, the AFAD-A classification classified overweight at risk and obesity adolescents into type-I (9.5% and 1.3%, respectively) and type-II (2.3% and 4.9%, respectively) depending if they had or not abdominal fatness.

Conclusions: There are differences between IOTF and WHO-2007 international references and there is a misclassification when adiposity is considered. The BMI limitations, especially for overweight identification, could be reduced by adding an estimate of both adiposity (FMI) and fat distribution (WHtR). The AFAD-A classification could be useful in clinical and population health to identify overfat adolescent and those

who have greater risk of developing weight-related cardiovascular diseases according to the BMI category.

***Keywords*:** adolescents; overweight; obesity; BMI; FMI; WHtR; AFAD-A

Introduction

In children and adolescents, the body mass index (BMI) for age has been established as the main measurement to define overweight and obesity, because it can be easily obtained and is correlated with percentage of body fat[1].

Despite some discussion, in epidemiological studies is general agreement on the appropriateness of BMI to define overweight and obesity with an international standard. Two international references are widely used: the International Obesity Task Force (IOTF) reference and the World Health Organization (WHO) standard 2007. The IOTF reference for children and adolescents 2–18 years old[2] was developed from a database of 97,876 boys and 94,851 girls from birth to 25 years from six countries (Brazil, Great Britain, Hong Kong, the Netherlands, Singapore and the USA). Centile curves were constructed using the LMS method, and BMI values of 25 and 30 at 18 years of age for boys and girls were tracked back to define BMI values for overweight and obesity at younger ages. The WHO-2007 standard for children and adolescents (5-19 years old)[3] was developed using the 1977 NCHS/WHO growth reference by addressing its limitations and linking construction to the WHO Child Growth Standards curves for children under five years old. Data points for children and adolescents with measurements suggestive of high adiposity were excluded. The total simple size used to generate the curves was 22,917 children. State of the art statistical techniques were used to construct and smooth the new growth curves.

Nevertheless, it became clear that using IOTF or WHO references on the same dataset yielded widely different rates[4-7]. Moreover, there are some limitations associated with the use of BMI as indicator of fatness, as follows: individuals with increased muscle mass may also have increased BMI; and also individuals with decreased lean body mass and increased adiposity may be misclassified by assessment with BMI; BMI fails to assess the accumulation of abdominal fat, which mainly increases the risk of diabetes, hypertension and CVD; and BMI is relatively insensible to body composition changes[8].

At higher levels, BMI and the BMI cut-offs may be help in informing a clinical judgement, but at levels near the norm additional criteria may be needed [9], such as skinfold thickness [10] or waist circumference (WC). We thus decided to carry out additional analysis to better explore this issue. The aims of this study were to compare the prevalence of overweight and obesity using the IOTF and the WHO-2007 references and interpret body composition by comparing measures of body weight (BMI) and body fatness (fat mass index, FMI; and waist-to-height ratio, WHtR) among the adolescent population of the Balearic Islands.

Methods

Study design

The study is a population-based cross-sectional nutritional survey carried out in the Balearic Islands (2007-2008).

Selection of participants, recruitment and approval

A multicenter study was performed on Balearic Islands' adolescents aged 12–17 years. The population was selected by means of a multiple-step, simple random sampling, taking into account first the location (Palma de Mallorca, Calvià, Inca, Manacor, Maó, Eivissa, Llucmajor, Santa Margalida, S'Arenal, Sant Jordi de Ses Salines) and then by random assignment of the schools within each city. Sample size was stratified by age and sex. The socioeconomic variable was considered to be associated to geographical location and type of school. As the selection of schools was done by random selection and fulfilling quota, this variable was also considered to be randomly assigned.

To calculate the number of adolescents to be included in the study in order to guarantee a representative sample of the whole Balearic Islands, we selected the variable with the greatest variance for this age group from the data published in the literature at the time the study was planned; that was BMI [11]. The sampling was determined for the distribution of this variable; the CI was established at 95% with an error ± 0.25. The established number of subjects was 1,500. The total number of subjects was uniformly distributed in the cities and proportionally distributed by sex and age group.

The sample was oversized to prevent loss of information and as necessary to do the fieldwork in complete classrooms. In each school, all the adolescents of one classroom were proposed to participate in the survey. A letter about the nature and purpose of the study informed parents or legal tutors. After receiving their written consent, the adolescents were considered for inclusion in the study. After finishing the field study, the adolescents who did not fulfil the inclusion criteria were excluded. Finally, the sample was adjusted by a weight factor in order to balance the sample in accordance to the distribution of the Balearic Islands' population and to guarantee the representativeness of each of the groups, already defined by the previously mentioned factors (age and sex). The final number of subjects included in the study was 1,231 adolescents (82% participation). The reasons to not participate were (a) the subject declined to be interviewed, and (b) the parents did not authorize the interview.

This 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 (Palma de Mallorca, Spain).

Anthropometric measurements

Height was determined using a mobile anthropometer (Kawe 44444, Asperg, Germany) to the nearest millimetre, with the subject's head in the Frankfurt plane. Body weight was determined to the nearest 100g using a digital scale (Tefal, sc9210, Rumilly, France). The subjects were weighed in bare feet and light underwear. The following circumferences were measured using a non-stretchable measuring tape (Kawe, 43972, France): mid-upper arm circumference (MUAC), WC, hip circumference (HC) and thigh circumference (TC). The subjects were asked to stand erect in a relaxed position with both feet together on a flat surface. MUAC was measured with as the midpoint of the length of the humorous. WC was measured as the smallest horizontal girth between the costal margins and the iliac crests at minimal respiration. HC was taken as the greatest circumference at the level of greater trochanters (the widest portion of the hip) on both sides. TC was measured below the gluteal fold. Measurements were made to the nearest 0.1 cm. Triceps and subscapular skinfold thickness (ST) were measured at the right side of the using a Holtain skinfold calliper (Tanner/Whitehouse, Crosswell, Crymych, UK), and the mean of three measurements was used. Body fat percentage (%BF) was measured from triceps and subscapular ST according to Slaughter et al.[12]. This equation has been proposed as the most accurate for estimation of %BF from ST in this particular population of adolescents[13]. Height and weight measures were used to calculate BMI (kg/m^2) and WC and height were used to calculate waist-to-height ratio (WHtR). %BF and height were used to calculate fat mass index (FMI; kg/m^2).

- Overweight and obesity definition

Overweight and obesity were determined based on age- and sex-specific BMI cut-offs as followed: 1) 85th percentile for overweight and 95th percentile for obesity using the WHO growth standards for children and adolescents[3], and 2) the cut-offs developed and proposed for international comparisons by Cole et al[2], recommended for use also by IOTF.

- Normal-fat and overfat definition

Normal-fat and overfat were determined using sex-specific cut-offs[14] for adolescents: 4.58 kg/m^2 in boys and 7.76 kg/m^2 in girls.

- Abdominal obesity definition

A WHtR cut-off of 0.5 was used to define abdominal obesity for both boys and girls[15].

- Adiposity & Fat Distribution classification for adolescents (AFAD-A classification)

On the basis of our results we proposed a new classification for adolescents based not only in body weight (BMI), but also adiposity (FMI) and fat distribution (WHtR): the Adiposity & Fat Distribution classification (AFAD-A) for adolescents (Table 1). In this classification, obesity was defined as a BMI-for age and sex ≥30 kg/m^2[2]; whereas normal-weight and overweight groups obtained by IOTF cut-offs were subgrouped according to presence or absence of overfat by FMI using the sex-specific cut-offs proposed by Alvero-Cruz et al.[14] for adolescents into four groups as follows: normal-weight normal-fat, normal-weight overfat, overweight normal-fat and overweight overfat. The overweight overfat and obesity groups were subgrouped according to presence or absence of abdominal obesity using a WHtR cut-off of 0.5[15].

Statistics

Analyses were performed with Statistical Package for the Social Sciences version 19.0 (SPSS, Inc., Chicago, IL, USA). Significant differences in prevalence were calculated by means of χ^2. Differences between groups' means were tested using ANCOVA adjusted by age. The level of significance was established for P values <0.05.

Results

Adolescents were classified according to their body weight by BMI using WHO-2007 and IOTF cut-offs, overall adiposity by FMI, and presence or absence of abdominal obesity by WHtR (Table 2). Large differences in overweight and obesity prevalence were obtained when results using WHO-2007 and IOTF cut-offs were compared. While obesity prevalence was higher using WHO-2007 (15.4%) than IOTF (6.1%) references; overweight prevalence was higher using IOTF (18.6%) than WHO-2007 (12.3%) cut-offs. Overall excessive weight (overweight and obesity) was higher by WHO-2007

(27.7%) than IOTF (24.7%). Nevertheless, results showed that using both BMI cut-offs the prevalence of excessive weight was higher than the percentage of overfat adolescents (19.8%) and adolescents with abdominal obesity (7.7%).

Table 3 shows the prevalence of normal-weight, overweight and obesity according to overall adiposity (FMI) and abdominal fatness (WHtR) cut-offs. Thus, the three body weight groups obtained by IOTF and WHO-2007 cut-offs (normal-weight, overweight and obesity) were subgrouped as follows: first, according to presence or absence of overfat; and then, according to presence or absence of abdominal obesity. Results showed that almost all obese adolescents (95.1%) were overfat by IOTF cut-offs, while 14.8% of adolescents classified by the WHO-2007 cut-offs as obese were normal-fat (2.3% of population). The overweight overfat prevalence was 11.9% by IOTF and 5.1% by WHO-2007 cut-offs, whereas overweight normal-fat prevalence was 6.7% and 7.1%, respectively. The prevalence of overweight normal-fat was higher among girls than boys using the IOTF cut-offs (P<0.001). Results also showed that the prevalence of normal-weight overfat adolescents was 2.1% by IOTF cut-offs and 1.5% by WHO cut-offs, which was higher in boys than girls independently of the cut-off used. Then, 20.2% of overweight overfat adolescents by IOTF cut-offs and 5.9% by WHO-2007 cut-offs had abdominal obesity, while these percentages increased to 78.7% and 46.1% in obese adolescents, respectively.

Therefore, results showed that among normal-fat adolescents, 91.3% were normal-weight and 8.4% were overweight using the IOTF cut-offs; whereas among overfat adolescents 29.3% were obese, 60.1% overweight and 10.6% normal-weight. Using the WHO-2007 cut-offs among normal-fat adolescents, 88.3% were normal-weight, 8.9% overweight and 2.9% obese; while among the overfat adolescents, 66.7% were obese, 25.8% overweight and 7.6% normal-weight. Among adolescents with abdominal obesity, 20.2% and 79.3% were overweight and obese using the IOTF cut-offs, respectively; whereas 5.2% were overweight and 92.2% obese using the WHO-2007 cut-offs. Independently of the BMI cut-offs used, 2.6% of adolescents with abdominal obesity were normal-weight (data not shown).

Figure 1 summarizes anthropometric measurements for the five main groups of the AFAD-A classification. Overall, results showed that whereas normal-weight normal-fat adolescents had lower means for BMI, WC, WHtR, %BF and FMI than their counterparts, normal-weight overfat boys showed lower mean BMI but higher means for %BF and FMI than their overweight normal-fat counterparts. The overweight overfat group also showed higher means BMI, WC, WHtR, %BF and FMI than the overweight normal-fat group but lower means than the obesity group.

Discussion

Overall, excessive weight (overweight plus obesity) was 27.7% using the WHO-2007 standard and 24.7% using the IOTF reference; whereas the prevalence of overfat by FMI using the cut-offs proposed by Alvero-Cruz et al.[14] was 19.8%; and 7.7% of adolescents had abdominal obesity. Using the IOTF cut-offs, while almost all obese adolescents were overfat (95.1%) and most of them had abdominal obesity (78.7%); about 36% of overweight adolescents were misclassified on the basis of the BMI alone –being higher among girls (56.7%) than boys (17%)-. Using the WHO cut-offs, 85.2% of obese adolescents were overfat and half of them had abdominal obesity; whereas 58.2% of overweight adolescents were normal-fat –being also higher among girls (73.4%) than boys (43.9%)-. Among the normal-weight group, using both IOTF and WHO-2007 cut-offs about 1.4-2.8% of adolescents were overfat, which was higher among boys (4-6%) than girls (<1%).

The present results agree with previous studies [4-7] which have pointed out that the IOTF reference and the WHO standard yield different results in terms of prevalence of overweight and obesity among the adolescent Balearic Islands population. Monasta et al.[4] have indicated that this is due to the different approaches used to define cut-offs and to the different criteria used to select the samples. Monasta et al.[4] also suggested that at the moment, IOTF reference and cut-offs could be preferable to identify overweight and obesity both at individual and population level because they are at least based on a crude association with ill health later in life, namely the definition of overweight and obesity at 18 years. However, it is important to note that in the present study both international references also provide high different results than the FMI using the cut-offs proposed by Alvero-Cruz et al.[14]. Of course BMI and FMI are different terms and although BMI performs moderately well as a proxy for these indicators, particularly at the upper end of the distribution curve[16], an important percentage of subjects classified as overweight or obese did not have really excess adiposity[17], percentage which may depend on the reference used.

The ideal definition of overweight and obesity would be based either on a close correlation with indicators of future cardiovascular and metabolic disease or on their ability to predict adverse future health outcomes[16]. Therefore, despite that BMI have been suggested as a good proxy for the screening of excess body fat in adolescents when considering a whole population, as in clinical settings others criteria may be also useful in epidemiological studies in which anthropometric measurements are used to screen overweight and obesity prevalence. Moreover, a single definition useful in both epidemiological and clinical settings should be achieved because epidemiological studies should determine the magnitude of the overweight and obesity problem in a population and also to stress the need for lifestyle changes while not exaggerating risks of future obesity and cardiovascular disease.

Because it is difficult to exclude BMI from the normal-weight and obesity definition despite that provides no information regarding the composition of the weight, or its distribution; FMI and WHtR could combine BMI for a better screening and surveillance. The FMI is a useful measure to evaluate body composition parameters by effectively eliminating differences in body fat associated with height[18]. Alvero-Cruz et al.[14] derived cut-off points for FMI from a sample of Spanish adolescents (150 subjects, 75 boys and 75 girls) showing that the FMI had higher accuracy for overweight screening than BMI. Their results pointed out in boys that predictive positive value (meaning the diagnosis of excessively fat adolescent as overweight) were 78.1% for BMI and 89.2% for FMI; and predictive negatives value (meaning the diagnosis of lean adolescent as non-overweight) were 81.4% for BMI and 100% for FMI in them. In girls, predictive positive value for BMI were 34.8%, predictive positive value for FMI were 81.4%; and predictive negative value for BMI and FMI were 98.1% and 100%, respectively. Combining BMI and FMI, our results suggest that IOTF cut-offs have high specificity for obesity –more than WHO cut-offs-, in our adolescent population. However, there was much less evidence on the optimal definition of being normal-weight or overweight. Therefore, the present results supported that a cut-off BMI≥30 kg/m^2 for age and sex[2] may be a good proxy for obesity in boys and girls, and also a cut-off BMI<25 kg/m^2[2] for age and sex for normal-weight in girls; whereas FMI may reduce misclassification among normal-weight boys and overweight adolescents. Thus, adolescents may be classified into five main groups as follows: normal-weight normal-fat, normal-weight overfat, overweight normal-fat, overweight overfat and obese.

It is also well established that central or visceral obesity is a major factor for the clustering of cardiovascular risk factors which defines the metabolic syndrome[19]. The determination of adolescents with abdominal obesity in both overweight and obesity status could useful to identify adolescents who being overweight or obese have higher probability for cardiovascular risk factors. Thus, overweight overfat and obesity adolescents could be classified into type-I and type-II according to the absence or presence of abdominal obesity, respectively. Abdominal obesity should be assessed by WHtR which has been proposed because of its ability to predict cardiovascular risk factors[20-23] and to estimate abdominal fat distribution[24], particularly in individuals who may not be classified as overweight or obese by BMI[12,14,15,25].

It is important to note that direct measurement of adiposity with sophisticated techniques is considered to be superior to indirect measures[26]. However, in many circumstances it is more desirable to utilize widely available and simple techniques such as anthropometry. Therefore, it should be recommended that not only BMI but also FMI and WHtR be used whenever possible in both clinical and epidemiological settings. Both, FMI assessed by skinfold thickness and WHtR are quick, cheap and simple anthropometric measurements which require only limited training and standardized assessment to obtain reliable data[13]. Moreover, both measurements are normalized for body size making comparisons between individuals or populations, or within individuals or populations over time, to be meaningful[27].

The contribution of this research may lead to better methods for measuring normal-weight and overweight to support this area of public health research, at least for a more accurate classification of Spanish adolescents because further research will be needed to evaluate the FMI cut-offs proposed by Alvero-Cruz et al.[14] to be generalized for international use. On the basis of our results, adolescents may be classified not only by body weight (BMI) but also adiposity (FMI) and fat distribution (WHtR). We proposed a new classification for adolescents, the Adiposity & Fat Distribution classification (AFAD-A) which classifies adolescents into the following groups: (1) normal-weight normal-fat; (2) normal-weight overfat; (3) overweight normal-fat; (4) overweight overfat (type-I and type-II, depending on the presence or absence of abdominal obesity, respectively), and (5) obesity (type-I and type-II). To facilitate the work of clinicians and epidemiologists, a questionnaire summarized as the AFAD-A classification is proposed (Table 5), despite that further research will be needed to evaluate its utility.

Conclusions

There are differences between IOTF and WHO-2007 international references and there is a misclassification when adiposity is considered. Surveillance, prevention and treatment of childhood and adolescent obesity require methods of defining obesity that are simple enough to be practical in most clinical and public health settings, but are also valid[28,29]. However, identification of adolescents in normal-weight and overweight with excess body fat is also important not only because they have some increased risk of adiposity-related comorbid conditions[8], but also psychosocial complications derived from body fatness[30]. Therefore, achieving a reliable and accurate estimation of body fatness and fat distribution is essential in both clinical and epidemiological settings. Our results support that it should be recommended that not only BMI but also FMI and WHtR be used whenever possible in both clinical and epidemiological settings.

Despite that further research will be needed to evaluate the utility of the AFAD-A questionnaire and classification, it could be the starting point towards an improvement in the traditional definition of normal-weight, overweight and obesity which may be a useful tool to surveillance adolescent's overweight on clinical and epidemiologic settings.

Limitations of the study

The cut-offs point considered for FMI were proposed by Alvero-Cruz et al.[14] and derived from 150 subjects (75 boys and 75 girls). However, as have been indicated by Alvero-Cruz et al.[14] the average values of basic anthropometric variables (weight, height and BMI) of other 450 subjects were not significant different from those of the sample assessed, indicating that these cut-offs should be useful for overweight diagnostic in Spanish adolescents.

Certainly, it is important to note that to calculate the FMI there is an intermediate step consisting of applying an equation that allows determining the percentage of body fat, and the value depends on the applied equation that increase error misclassification. Rodríguez et al.[13] compared the most commonly used equations to predict body fatness from skinfold thickness with DEXA and found that most equations did not demonstrated good agreement compared with DEXA. However, they proposed that Slaughter et al.[12] equations may be used in adolescents from both sexes to predict BF when a relative index of fatness is required in field or clinical studies. Nevertheless, the present study did not take into account pubertal development despite that chronological age may vary dramatically during this phase. Adolescents have been classified according to their pubertal stage, boys were divided into two groups: pubertal (12 to 14 y-o) and post-pubertal (15 to 17 y-o)[31].

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designed, devised and supervised the study, MMB and JAT collected and supervised the samples. MMB and JAT analysed the data and wrote the manuscript. AP and JAT obtained funding. *Conflict of interests*: The authors state that there are no conflicts of interest.

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Table 1. A proposal classification of adolescents according to their body weight (BMI), adiposity (FMI) and fat distribution (WHtR): the Adiposity & Fat Distribution classification for adolescents (AFAD-A classification)[1]

Body composition markers	
Categories	**Cut-offs**
Normal-weight	BMI-for age and sex<25 kg/m^2
Normal-fat	Boys: FMI<4.58 kg/m^2
	Girls: FMI<7.76 kg/m^2
Overfat	Boys: FMI≥4.58 kg/m^2
	Girls: FMI≥7.76 kg/m^2
Overweight	BMI-for age and sex ≥25-<30 kg/m^2
Normal-fat	Boys: FMI<4.58 kg/m^2
	Girls: FMI<7.76 kg/m^2
Overfat	Boys: FMI≥4.58 kg/m^2
	Girls: FMI≥7.76 kg/m^2
Type-I	WHtR<0.5
Type-II	WHtR≥0.5
Obesity	BMI-for age and sex ≥30 kg/m^2
Type-I	WHtR<0.5
Type-II	WHtR≥0.5

Abbreviations: BMI, body mass index; FMI, fat mass index; WHtR, waist-to-height ratio.
[1]The AFAD-A classification was developed using the International Obesity Task Force (IOTF) cut-offs for BMI categories[12].

Table 2. Prevalence (%) of overweight and obesity (by BMI), adiposity (by FMI) and abdominal obesity (by WHtR) among the Balearic Islands' adolescents, Spain (2007-2008)

Anthropometric variable			**Cut-offs**	**Total (%)**	**Boys (%)**	**Girls (%)**	***P***
BMI (kg/m^2)	IOTF	Normal-weight	BMI-for age and sex<25 kg/m^2	75.3	72.3	77.8	*
		Overweight	BMI-for age and sex ≥25-<30 kg/m^2	18.6	21.2	16.4	*
		Obesity	BMI-for age and sex ≥30 kg/m^2	6.1	6.5	5.8	NS
	WHO-2007	Normal-weight	BMI-for age and sex <P85	72.3	67.7	76.1	**
		Overweight	BMI-for age and sex ≥P85-<P95	12.3	13.9	10.9	NS
		Obesity	BMI-for age and sex ≥P95	15.4	18.3	13.0	*
FMI (kg/m^2)		Normal-fat	Boys: FMI<4.58 kg/m^2 Girls: FMI<7.76 kg/m^2	80.2	72.3	86.8	***
		Overfat	Boys: FMI≥4.58 kg/m^2 Girls: FMI≥7.76 kg/m^2	19.8	27.7	13.2	***
WHtR		Absence of abdominal obesity	WHtR<0.5	92.3	91.6	92.9	NS
		Abdominal obesity	WHtR≥0.5	7.7	8.4	7.1	NS

Abbreviations: BMI, body mass index; FMI, fat mass index; WHtR, waist-to-height ratio; IOTF, International Obesity Taskforce; WHO, World Health Organization.
Significant differences (boys *vs.* girls) by χ^2 (*P<0.05, **P<0.01, ***P<0.001). NS: not significant.

Table 3. Prevalence (%) of normal-weight, overweight and obesity using different indicators for the condition in Balearic Islands' adolescent population, Spain (2007-2008)

Body composition markers		Total		Boys		Girls		P^3	P^4
Categories	**Cut-offs**	**WHO-2007[1]**	**IOTF[2]**	**WHO-2007[1]**	**IOTF[2]**	**WHO-2007[1]**	**IOTF[2]**		
Normal-weight[1,2]									
Normal-fat	FMI<4.58/7.76 kg/m^2 (boys/girls)	70.8	73.2	64.9	68.3	75.8	77.4	***	**
Overfat	FMI≥4.58/7.76 kg/m^2 (boys/girls)	1.5	2.1	2.9	4.0	0.3	0.5	***	***
Overweight[1,2]									
Normal-fat	FMI<4.58/7.76 kg/m^2 (boys/girls)	7.1	6.7	6.1	3.6	8.0	9.3	NS	***
Overfat	FMI≥4.58/7.76 kg/m^2 (boys/girls)	5.1	11.9	7.8	17.6	2.9	7.1	***	***
Not abdominal obesity	WHtR<0.5	4.8	9.5	7.3	14.1	2.7	5.6	***	***
Abdominal obesity	WHtR≥0.5	0.3	2.4	0.6	3.4	0.2	1.4	NS	*
Obesity[1,2]									
Normal-fat	FMI<4.58/7.76 kg/m^2 (boys/girls)	2.3	0.3	1.3	0.4	3.0	0.2	NS	NS
Overfat	FMI≥4.58/7.76 kg/m^2 (boys/girls)	13.2	5.8	17.0	6.1	10.0	5.6	***	NS
Not abdominal obesity	WHtR<0.5	6.5	1.2	9.5	1.5	4.0	1.0	***	NS
Abdominal obesity	WHtR≥0.5	6.6	4.6	7.4	4.6	5.9	4.7	NS	NS

Abbreviations: BMI, body mass index; FMI, fat mass index; WHtR, waist-to-height ratio; IOTF, International Obesity Taskforce; WHO, World Health Organization.
Adolescents were classified on the basis of their BMI using the [1]WHO-2007 and [2]IOTF international references. [1]WHO-2007[3] cut-offs: normal-weight, BMI-for age and sex <P85; overweight, BMI-for age and sex ≥P85-<P95; obesity, BMI-for age and sex ≥P95. [2]IOTF[2] cut-offs; normal-weight, BMI for age and sex <25 kg/m^2; overweight, BMI-for age and sex ≥25-BMI-<30 kg/m^2; obesity, BMI for age and sex ≥30 kg/m^2.
Significant differences (boys *vs.* girls) by χ^2 using [3]WHO-2007 and [4]IOTF references (**P*<0.05, ***P*<0.01, ****P*<0.001). NS: not significant.

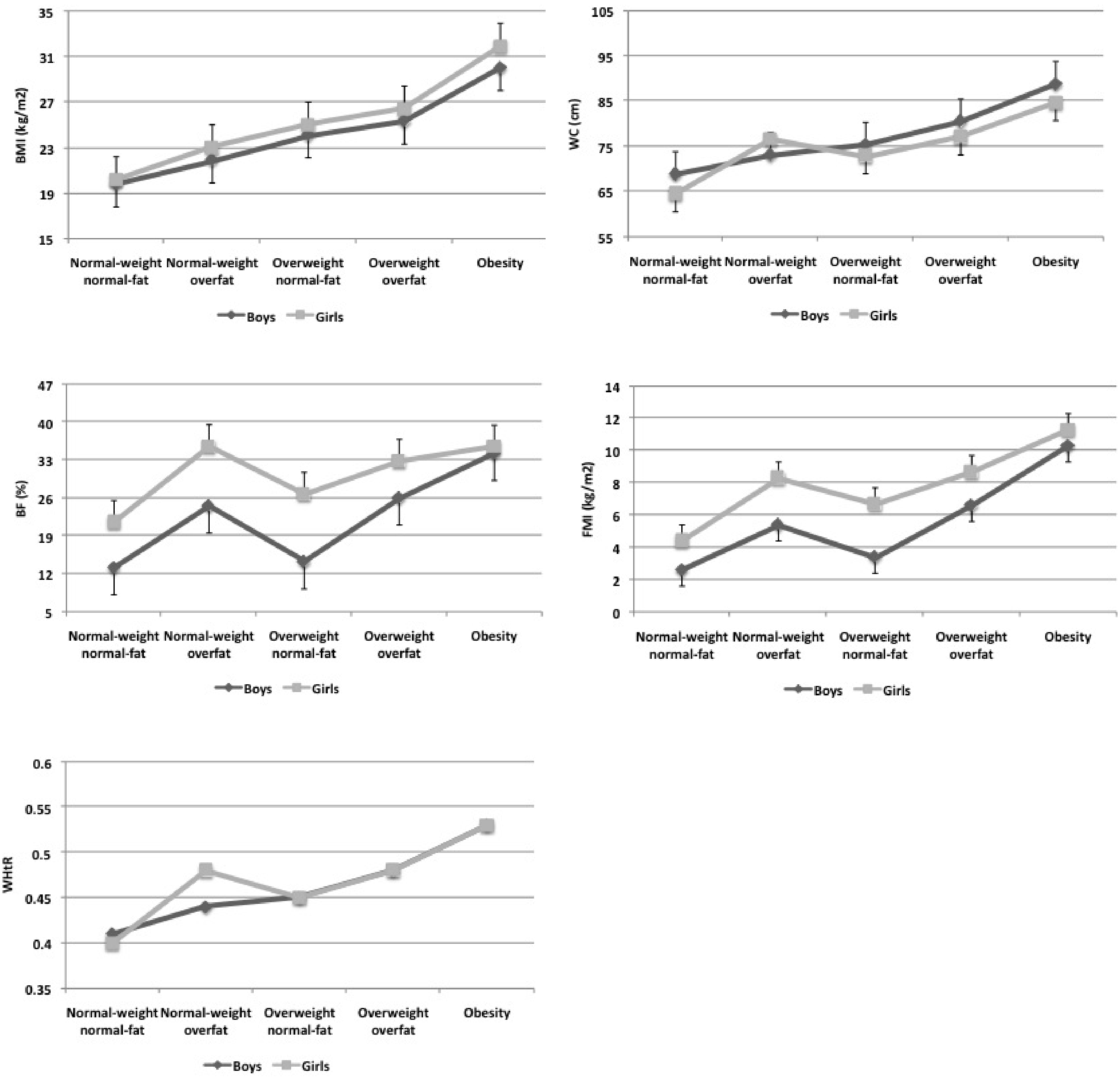

Figure 1. BMI, WC, WHtR, %BF and FMI (mean values ± SD) by the AFAD-A classification. Analysis was adjusted by age.

Table 4. A proposal questionnaire to classify adolescents according to their body weight, adiposity and fat distribution: the AFAD-A questionnaire classification

Question	Result
1. What body mass index (BMI, kg/m^2) has the subject according to their sex and age (applied Cole et al, 2000 cut-offs)?	
a. BMI for age and sex <25 kg/m^2 (go to *question 2*)	***Normal-weight***
b. BMI for age and sex ≥25 e IMC<30 kg/m^2 (go to *question 3*).	***Overweight***
c. BMI for age and sex ≥30 kg/m^2 (go to *question 4*).	***Obesity***
2. If they are **normal-weight**: What fat mass index (FMI, kg/m^2) has the subject according to their sex?	
a. Boys: FMI<4.58 kg/m^2; girls: FMI<7.76 kg/m^2.	***Normal-weight normal-fat***
b. Boys: FMI≥4.58 kg/m^2; girls FMI≥7.76 kg/m^2.	***Normal-weight overfat***
3. If they are **overweight**: What fat mass index (FMI, kg/m^2) has the subject according to their sex?	
a. Boys: FMI<4.58 kg/m^2; girls: FMI<7.76 kg/m^2.	***Overweight normal-fat***
b. Boys: FMI≥4.58 kg/m^2; girls FMI≥7.76 kg/m^2 (go to *question* 4).	***Overweight overfat***
4. If they are **overweight at risk** or **obesity**: What waist-to-height ratio (WHtR) has the subject (independently of their sex and age)?	
a. WHtR<0.5.	***Overweight overfat*** *or* ***Obesity type-I***
b. WHtR≥0.5.	***Overweight overfat*** *or* ***Obesity type-II***

Manuscrit VI

Sedentary behaviour among the Balearic Islands' adolescents: socioeconomic and lifestyle determinants.

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Sedentary behaviour among the Balearic Islands adolescents: socioeconomic and lifestyle determinants.

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Abstract

Objective: To assess sedentary behaviour among the Balearic Islands adolescents, and socioeconomic and lifestyle determinants.

Methods: Two cross-sectional surveys carried out in the Balearic Islands, Spain (2007-08). A random sample (*n*=1961) of the adolescent population (12-17 years old) was interviewed. Physical activity was assessed using the International Physical Activity Questionnaire (IPAQ) adapted for adolescents. Sedentary behaviour was defined as <300 min/week of moderate and vigorous physical activity. Anthropometric measurements, body image, socio-economic and lifestyle determinants, food consumption, and adherence to the Mediterranean diet were assessed.

Results: The prevalence of sedentary behaviour among adolescents was 37.1% (22.0% boys, 50.8% girls). Sedentary behaviour of girls was directly associated to age, time spent on media screen and homework, and parental educational and professional level, and inversely related to adherence to Mediterranean diet, and overweight/obesity. Sedentary behaviour of boys was inversely related to overweight/obesity, adherence to the Mediterranean diet, and the desire to be thinner and to remain the same weight. More active boys consumed frequently breakfast cereals and fresh fruits than their sedentary peers. More active girls consumed frequently yogurt and cheese, and breakfast cereals than their sedentary counterparts. Sedentary girls consumed more frequently high foods and soft drinks than their active peers.

Conclusions: The prevalence of sedentary behaviour among the Balearic Islands' adolescents is high, mainly among girls. Age, sex, parental educational and

professional levels, dissatisfaction with body size and poor quality diet are important determinants of physical activity practice among adolescent population.

Keywords: physical activity, sedentary behaviour, food quality, adolescents

Introduction

Adolescence is a transitional stage and many changes take place at physiologic and behavioural levels, representing an important life stage for the development of healthy nutrition [1] and physical activity behaviours. Many different factors influenced food habits and physical activity patterns in a complex interactive way [2]. Socio-cultural factors as parental occupational status, maternal level of education, cultural and/or religious habits, and the role of family and patterns of beauty are factors that have a strong influence on eating habits [3] and physical activity in adolescents [4-7].

Reductions in physical activity in youth as a result of adopt a major inactive lifestyle, increasing time spent watching television, playing video games and Internet over the past two decades are believed to explain part of the rising prevalence of obesity in children and adolescents [8-10]. The prevalence of overweight and obesity among children and adolescents has risen greatly worldwide [8], with current estimates suggesting that around 30% of boys and 25% of girls in the Balearic Islands are overweight or obese [11]. However, physical inactivity has been related not only to obesity but also to the associated morbidity and non transmittable chronic diseases [12], being one of the major importance in public health because is highly prevalent [13,14].

Cohort studies have evidenced that physical inactivity during childhood and/or adolescence tends to continue into adulthood, becoming difficult to change [7,15]. However, among environmental factors of obesity and risk of disease the lack of regular physical activity is potentially modifiable [13] and programs to stimulate physical activities in this age range should be a priority for public health policies and a focus for teachers [7]. Despite the acknowledgement that physical activity is important for health, there are not population-based studies about this topic among the Balearic Islands' adolescents. Therefore, the aim of this study was to assess sedentary behaviour among the Balearic Islands' adolescents, as well as socioeconomic and lifestyle determinants.

Materials and Methods

Study design

The study is a population-based cross-sectional nutritional survey carried out (2007-2008) in the Balearic Islands, a Mediterranean region.

Selection of participants, recruitment and approval

A multicenter study was performed on Balearic Islands' adolescents aged 12–17 years. The population was selected by means of a multiple-step, simple random sampling, taking into account first the location (Palma de Mallorca, Calvià, Inca, Manacor, Maó, Eivissa, Llucmajor, Santa Margalida, S'Arenal, Sant Jordi de Ses Salines) and then by random assignment of the schools within each city. Sample size was stratified by age and sex. The socio-economic variable was considered to be associated to geographical location and type of school. As the selection of schools was done by random selection and fulfilling quota, this variable was also considered to be randomly assigned.

To calculate the number of adolescents to be included in the study in order to guarantee a representative sample of the whole Balearic Islands, we selected the variable with the greatest variance for this age group from the data published in the literature at the time the study was planned; that was BMI [16]. The sampling was determined for the distribution of this variable; the CI was established at 95% with an error ± 0.25. The established number of subjects was 2400. The total number of subjects was uniformly distributed in the cities and proportionally distributed by sex and age group. Exclusion criteria were: type 2 diabetes, pregnancy, alcohol or drug abuse, and non-directly related nutritional medical conditions.

The sample was oversized to prevent loss of information and as necessary to do the fieldwork in complete classrooms. In each school, all the adolescents of one classroom were proposed to participate in the survey. A letter about the nature and purpose of the study informed parents or legal tutors. After receiving their written consent, the adolescents were considered for inclusion in the study. After finishing the field study, the adolescents who did not fulfil the inclusion criteria were excluded. Finally, the sample was adjusted by a weight factor in order to balance the sample in accordance to the distribution of the Balearic Islands' population and to guarantee the representativeness of each of the groups, already defined by the previously mentioned factors (age and sex). The final number of subjects included in the study was 1961 adolescents (82% participation). The reasons to not participate were (a) the subject declined to be interviewed, and (b) the parents did not authorize the interview.

This 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 (Palma de Mallorca, Spain).

Anthropometry measurements

Height was determined using a mobile anthropometer (Kawe 44444, Asperg, Germany) to the nearest millimetre, with the subject's head in the Frankfurt plane. Body weight was determined to the nearest 100g using a digital scale (Tefal, sc9210, Rumilly, France). The subjects were weighed in bare feet and light underwear. Waist circumference (WC) and hip circumference (HC) were measured using a non-stretchable measuring tape (Kawe, 43972, France). The subjects were asked to stand erect in a relaxed position with both feet together on a flat surface. WC was measured as the smallest horizontal girth between the costal margins and the iliac crests at minimal respiration. Measurements were made to the nearest 0.1 cm. HC was taken as the greatest circumference at the level of greater trochanters (the widest portion of the hip) on both sides. Measurements were made to the nearest 0.1 cm. Triceps and subscapular skinfold thickness (ST) were measured at the right side of the using a Holtain skinfold caliper (Tanner/Whitehouse, Crosswell, Crymych, UK), and the mean of three measurements was used. Body fat percentage (%BF) was measured from triceps and subscapular ST according to Slaughter et al. [17]. This equation has been proposed as the most accurate for estimation of %BF from ST in this particular population of adolescents [18]. Height and weight measures were used to calculate body mass index (BMI, kg/m^2) and WC and height were used to calculate waist-to-height ratio (WHtR). %BF and height were used to calculate fat mass index (FMI; kg/m^2).

Defining overweight and obesity

Adolescents were classified into three groups as follows: (i) not at risk (BMI for age and sex <25 kg/m^2; FMI<4.58 kg/m^2 in boys, FMI<7.76 kg/m^2 in girls); (ii) overweight (BMI for age and sex <30kg/m^2; FMI≥4.58 kg/m^2 in boys, FMI≥7.76 kg/m^2 in girls); and (iii) obesity (BMI for age and sex ≥30-BMI kg/m^2; FMI≥4.58 kg/m^2 in boys, FMI≥7.76 kg/m^2 in girls). The variable was labeled as 'body composition' [19]. Age- and sex-specific BMI cut-offs were used according to the International Obesity Task Force and Cole et al. definitions [20], and FMI cut-offs according to Alvero-Cruz et al. [21] criteria for adolescents: 4.58 kg/m^2 in boys and 7.76 kg/m^2 in girls, as the limit between normal-fat and overfat.

Body image

Perceived body image was measured using the Stunkard scale [22], which consists of silhouette drawings ranging from 1 to 9 with monotonic increments in overweight percentage where 1 is the leanest and 9 is the heaviest. Separate figures for boys and girls were used. Participants were asked to identify of the 9 body figures: (a) 'Which silhouette looks most like yourself?' and (b) 'Which silhouette would you like to look like?' The difference between perceived body image and desired body image was used to determine the level of dissatisfaction with current body image. Values other than zero represent dissatisfaction with perceived body image. A positive value was indicative of the participant's desire to be thinner than his/her perceived current size, while a negative value reflected the participant's desire to be thicker than his/her current perceived size [23,24].

Assessment of physical activity

Physical activity was evaluated according to the guidelines for data processing and analysis of the international physical activity questionnaire (IPAQ) [25] in the short form, and its specific modification for adolescents (IPAQ-A) [26]. The specific types of activity assessed were walking, and moderate (i.e. physical activity at school), and vigorous (i.e. sport practice) activity. According to the AVENA (Food and Assessment of Nutritional Status of Adolescents) study [27], the questionnaire also included information on television (TV) viewing, computer use and video games and homework in h/d, and usual sleep duration to the nearest 10 min. According to recent reports of physical activity for adolescents [7,28], sedentary behaviour was established with a cut-off level of 300 minutes of moderate/vigorous physical activity (MVPA) per week.

Socio-economic and lifestyle determinants

A questionnaire incorporating general, socio-economic and lifestyle determinants was used. It included: age group; parental educational level (according to years and type of education: low, <6 years; medium, 6-12 years; high, >12 years); and parental socio-economic level (based on the occupation of parents and classified as low, medium and high, according to the Spanish Society of Epidemiology [29]. The number of daily meals and snacks was calculated from the total eating occasions that participants declared among the following: breakfast; mid-morning snack; lunch; mid-afternoon snack; dinner; before going to sleep; others. Three groups of eating frequency were considered: ≤3, 4 and ≥5 times/d.

Dietary assessment

Dietary questionnaires included two non-consecutive 24 hour diet recalls and a semi-quantitative food-frequency questionnaire (FFQ) previously validated [30]. 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. Edible fractions of foods were recorded in the database. The 145 foods items from the FFQ were collapsed to twenty-nine food groups, which may have practical importance in daily diet and clinical practice among Mediterranean younger [31,32].

Adherence to the Mediterranean diet

The degree of adherence to the Mediterranean diet was evaluated using the KIDMED index (Mediterranean diet quality index for children and adolescents), described elsewhere [33]. Based on the given answers, the test classified individuals according to the quality of the Mediterranean diet categorized as: high, medium or poor.

Statistics

Analyses were performed with Statistical Package for the Social Sciences version 19.0 (SPSS, Inc., Chicago, IL, USA). All tests were stratified by sex. Significant differences in prevalence were calculated by means of χ^2. Difference between groups means were tested using ANOVA. Logistic regression models with the calculations of corresponding adjusted odds ratios and 95% confidence intervals were used to examine possible differences between those adolescents who were physically inactive or active. Univariate analysis was first carried out for all the socio-demographic and lifestyle variables that could be associated with insufficient physical activity. Any factor that was significantly associated was considered as a candidate for the multivariate model. Multiple logistic regression analyses were used to simultaneously examine the effect of different socio-demographic and lifestyle variables on the prevalence of insufficient physical activity. Multiple logistic regression analyses were also used to simultaneously examine the association between physical activity and dietary patterns adjusted by potential confounders (e.g. age, parental educational, parental socio-economic status, body composition number of daily meals and snacks and desire for weight change). Level of significance for acceptance was $P<0.05$.

Results

Table I shows physical activity and lifestyle of the Balearic Islands' adolescents stratified by sex and age. Sedentary behaviour among adolescents was 37.1%. Boys were more active and spend more weekly time in both moderate and vigorous physical activity than girls, and boys were devoted more weekly time to vigorous physical activity (64%) than girls (50%). Girls (50.8%) showed higher sedentary behaviour than boys (22.0%), and this prevalence increased with age, whereas time devoted to vigorous physical activity decreased with age. Time devoted to media screen was higher among 14-y.o. boys and girls; and time spent on homework and sleep time increased with age in girls, but not in boys.

Risk factors of sedentary behaviour among the Balearic Islands' boys and girls are showed in Table II. Sedentary behaviour of girls was directly related to age, time spent on media screen and homework, and parental educational and professional level, and inversely related to adherence to Mediterranean diet, and overweight/obesity. Sedentary behaviour of boys was inversely related to overweight/obesity, adherence to the Mediterranean diet, and the desire to be thinner and to remain the same weight.

Table III shows anthropometric characteristics of the Balearic Islands' adolescents according to physical activity practice and stratified by sex. Sedentary boys showed higher adiposity (measured by means of BMI, WC, HC, TSF, SCSF, %BF and WHtR), and sedentary girls showed lower weight, BMI and HC than their active counterparts.

Food consumption among active and sedentary Balearic Islands' adolescents is showed in Table IV. More active boys consumed frequently breakfast cereals and fresh fruits than their sedentary peers. More active girls consumed frequently yogurt and cheese, and breakfast cereals than their sedentary counterparts. Sedentary girls consumed more frequently high foods and soft drinks than their active peers.

Discussion

Our study has assessed that sedentary behaviour among the Balearic Islands' adolescents is high (37.1%), mainly among girls (22% boys and 50.8% girls), but lower than those of American (55.9%) [34] Brazilian (56.9%) [35] and other European adolescents [376].

In our study boys were more active than girls in all age groups, and sex difference was accentuated with age for a significant declined physical activity practice in girls. Adolescence is the beginning of the decline of physical activity practice [37], which decreases annually about 2.7% among boys and 7.4% among girls between the ages of 10 and 17 [38]. Among the Balearic Islands' adolescents, the physical activity practice decreases annually 1.3% (boys) and 3.2% (girls). These results confirm that age and sex are important determinants of physical activity practice among adolescent population [39].

Parental educational and socio-economic levels have been also associated with adolescents' sedentary behaviour [7,39,40]. In our study, the intergenerational association between parental educational and professional levels with sedentary behaviour was observed in girls but not in boys. Among Canary Islands' adolescents [41], father's regular physical activity in case of boys and mother's one in case of girls was positively associated with the likelihood of being active. Moreover, family usually supports engagement to physical activity practice more on boys than girls [42]. It has been also found that the access to physical activity spaces, by means of a combination of outdoor and indoor facilities, has been positively associated with the likelihood of being active in girls [41]. The access to these facilities is strongly related to the parental educational and economic level, which explains our results.

The measurement of sedentary behaviour is not a well-developed field. We used time spend on use of media-screen, homework and sleep as measures of overall sedentary behaviour in adolescents. Our results showed that sedentary behaviour was associated with spending ≥4 hours per day on use media-screen and spending ≥3 hours per day doing homework in girls, which agrees previous findings about sex differences in sedentary behaviours [43-44]. Our results suggest a displacement of physical activity to sedentary pursuits in girls with age, whereas in boys the use of media-screen or homework would not necessarily affect the physical activity practice. These findings agree previous results that pointed out that the excess time accumulated in front of screens is negatively associated with MVPA in adolescents [41]. However, our study shows that time spends on media-screen and homework are useful to distinguish between active and sedentary girls.

In the present study, a significant relationship was found between body composition and physical activity practice but this association was controversial for boys and girls. Thus, in agreement with previous findings reported in young people and adults [4,45,46], overweight and obese boys were more sedentary than their normal-weight (not at risk) counterparts; whereas obese girls were often more active than their lean peers. Although we cannot exclude the possibility that obese girls increased their physical activity as a method to self-control body weight, it may be possible that obese girls over-reported their physical activity practice.

Being self-conscious about one's body size may play a role in influencing a variety of health behaviours, such as physical activity practice; however, limited research to date has been focused on the relationship of body size satisfaction and physical activity practice. Findings from the literature indicate gender differences between men and women in how they see their bodies and how this may affect their physical activity practice [47]. A previous study on adults suggested that both men and women who were unsatisfied with their body size were less likely to be regularly active than those who were satisfied [47]. Similar results in boys but not in girls were observed in our study, which could be explained because boys are more likely to practice physical activity as strategy to increase body weight and muscle mass [48], while girls are more likely to meet the patterns of beauty attempting to lose weight, mainly by diets [49]. Our findings also support the suggestion [47] that a sedentary lifestyle in unsatisfied boys may also lead a self-perpetuating vicious circle of low activity.

Physical activity practice has been associated with food choice, and cereals, fruits and vegetables often appear in the diet of active adults and children [50]. Children who follow a healthy diet are those who might also maintain high levels of physical activity [51]. In a previous study, we found that sedentary and low-active adolescents showed the lowest adherence to the Mediterranean dietary pattern [19]. The present results showed that sedentary adolescents often consumed less cereals, fruits and fish & seafood, whereas chocolates and high fat foods appeared often in their diet.

Moreover, we have lately described two major dietary patterns in the Balearic Islands' adolescent population: the 'Western' and the 'Mediterranean' pattern [19]. In the present study we have observed that adolescents who spent ≥4 hours per day on use media-screen also showed higher mean intake for most of the food categories included in the 'Western' dietary pattern (e.g. dairy desserts, red meat, sausages, bread, rice dishes, fruit juices, soft drinks, high-fat foods, sweets and chocolates), whereas mean intake for yogurt & cheese, fruit and vegetables was lower in them. Therefore, in addition to the promotion of physical activity, reductions in sedentary behaviour (i.e. media-screen time) with education programmes focused on strategies to promote healthy food choices (i.e.: following the Mediterranean diet) should be considered in nutrition education programmes for adolescents aimed at reducing risk of disease.

Limitations of the study

In the literature there are important methodological differences in instruments and cut-off points which frequently prevent comparisons among studies [52]. Questionnaires have inherent limitations, mainly because they are subjective in nature. Self-report of physical activity can lead to overreport the physical activity due to a social desirability bias, and therefore the number of inactive individuals may be lower than that reported [53,54], especially among children and adolescents, and also among obese [53]. Moreover, sedentary behaviours may be more difficult to remember than activities of higher intensity [55] and recall bias in self-reported sedentary behaviours have been reported among adolescents [56]. Therefore, objective methods are generally preferable in assessing dimensions of physical activity in young people [4]. An extensive range of instruments for measuring physical activity has been reported in the literature, but critical elements in the utility of an instrument to measure physical activity are to be relatively inexpensive, cause minimal inconvenience to the participant, and be able to be administered with relative ease [57]. However, in epidemiological studies, self-reporting is usually the most feasible method of assessing physical activity, especially when a high number of participants are interviewed [4].

Conclusions

The prevalence of sedentary behaviour among the Balearic Islands' adolescents is high, mainly among girls. Age, sex, parental educational and professional levels, dissatisfaction with body size and poor quality diet are important determinants of physical activity practice among adolescent population. Adolescents are priority targets for action against obesity and related comorbidities, and they should be more aware about the health benefits of physical activity practice. Programmes to promote physical activity and reductions in sedentary behaviour among not only adolescents but also their families, combined with a Mediterranean diet, would likely result in a better healthy profile in the future.

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Authors' contributions

MMB and JAT conceived, designed, devised and supervised the study, MMB and JAT collected and supervised the samples. MMB, AC and JAT analysed the data and wrote the manuscript. AP and JAT obtained funding. All authors read and approved the final manuscript.

Conflict of interests

The authors state that there are no conflicts of interest.

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Table 1. Physical activity and lifestyle of the Balearic Islands' adolescents stratified by sex and age.

		Age group				
		Total	**12-13**	**14-15**	**16-17**	***P***
Boys	***n***	939	240	445	254	
	Physical activity[1] (%)†					
	Inactive	22.0	17.6	23.2	24.0	NS
	Active	78.0	82.4	76.8	76.0	
	Physical activity practice					
	Moderate					
	Did not engage (%)†	8.9	7.2	7.6	12.8	*
	Mean duration (min/week)‡	215.1 ± 250.5	264.9 ± 330.2[a]	192.6 ± 200.7[a]	208.4 ± 237.7	**
	Time spent (% total)†	35.7 ± 28.6	35.2 ± 24.6	35.9 ± 27.3	35.7 ± 28.6	NS
	Vigorous					
	Did not engage (%)†	11.0	8.0	11.1	13.6	NS
	Mean duration (min/week)‡	502.8 ± 401.4	558.7 ± 454.2	486.6 ± 387.3	477.8 ± 367.6	NS
	Time spent (%)†	64.3 ± 27.0	64.8 ± 24.6	64.1 ± 27.3	64.3 ± 28.6	NS
	Media-screen time (%)†					
	<2 h/d	17.6	21.2	16.0	17.1	*
	2-4 h/d	42.6	47.7	41.1	40.2	
	≥4 h/d	39.8	31.1	42.8	42.7	
	Homework time (%)†					
	<1 h/d	16.3	13.8	19.1	13.8	NS
	1-3 h/d	69.7	69.7	69.3	70.4	
	≥3 h/d	14.0	16.5	11.6	15.8	
	Sleep time (%)†					
	<7 h/d	9.5	7.1	9.2	12.2	NS
	≥7 h/d	90.5	92.9	90.8	87.8	
Girls	***n***	1022	255	503	264	
	Physical activity[1] (%)†					
	Inactive	50.8	41.4	51.9	57.3	**
	Active	49.2	58.6	48.1	42.7	
	Physical activity practicse					
	Moderate					
	Did not engage (%)†	12.7	7.9	11.0	20.0	***
	Mean duration (min/week)‡	169.1 ± 165.7	188.5 ± 210.5	164.1 ± 147.1	158.8 ± 146.1	*
	Time spent (% total)†	50.4 ± 33.7	47.2 ± 31.6	52.0 ± 33.7	50.6 ± 35.8	NS
	Vigorous					
	Did not engage (%)†	28.4	20.3	29.4	33.8	**
	Mean duration (min/week)‡	354.3 ± 356.2	422.6 ± 470.4[a,b]	338.9 ± 313.8[a]	308.5 ± 267.2[b]	**
	Time spent (%)†	49.6 ± 33.7	52.8 ± 31.6	48.0 ± 33.7	49.4 ± 35.8	NS
	Media-screen time (%)†					
	<2 h/d	21.2	28.0	17.5	21.6	**
	2-4 h/d	38.7	41.0	36.3	40.9	
	≥4 h/d	40.2	31.0	46.2	37.5	
	Homework time (%)†					
	<1 h/d	8.3	8.9	10.0	4.3	**
	1-3 h/d	66.0	68.5	67.6	60.9	
	≥3 h/d	25.7	22.6	22.4	34.8	
	Sleep time (%)†					
	<7 h/d	8.9	3.1	9.7	12.9	***
	≥7 h/d	91.1	96.9	90.3	87.1	

[1]Physical inactivity was defined as <300 min/week of moderate and vigorous physical activity (Ferreira et al, 2009). Values are mean ± SD and %. Significant differences between age groups by: †χ^2 and ‡ANOVA: *p<0.05; **p<0.01; ***p<0.001. NS: not significant.
Significant differences between pairs of means by Bonferroni's *post-hoc* test (P<0.05): [a]'12-13' *vs.* '14-15'; [b]'12-13' *vs.* '16-17'.

Table 2. Risk factors of sedentary behaviour among the Balearic Islands' adolescents.

	Boys			Girls		
Variable	**Sedentary adolescents (%)**	**Crude OR (95% CI)** [a]	**Adjusted OR (95% CI)**[b]	**Sedentary adolescents (%)**	**Crude OR (95% CI)** [a]	**Adjusted OR (95% CI)** [b]
Age group						
12-13 years old	17.6	0.68 (0.43-1.06)	0.70 (0.39-1.23)	41.1	0.53 (0.37-0.75)***	0.61 (0.40-0.95)*
14-15 years old	23.2	0.96 (0.66-1.38)	0.90 (0.58-1.41)	51.9	0.80 (0.59-1.09)	0.91 (0.64-1.29)
16-17 years old	24.0	1.00 (ref.)	1.00 (ref.)	57.3	1.00 (ref.)	1.00 (ref.)
Parental educational level						
Low	22.9	1.17 (0.79-1.74)	0.85 (0.50-1.44)	56.1	1.66 (1.21-2.28)**	1.18 (0.76-1.82)
Medium	21.4	1.08 (0.72-1.60)	1.21 (0.72-2.02)	51.0	1.35 (0.98-1.87)	1.18 (0.78-1.78)
High	20.2	1.00 (ref.)	1.00 (ref.)	43.5	1.00 (ref.)	1.00 (ref.)
Parental professional level						
Low	21.7	1.08 (0.66-1.75)	0.73 (0.37-1.42)	56.8	1.70 (1.15-2.50)**	1.23 (0.74-2.06)
Medium	22.4	1.12 (0.71-1.76)	0.94 (0.53-1.69)	46.9	1.14 (0.78-1.66)	1.06 (0.67-1.69)
High	20.5	1.00 (ref.)	1.00 (ref.)	43.6	1.00 (ref.)	1.00 (ref.)
Body composition						
Not at risk	19.1	0.39 (0.22-0.70)**	0.61 (0.28-1.36)*	51.6	1.82 (0.98-3.36)*	2.06 (1.03-4.13)*
Overweight	30.9	0.75 (0.40-1.40)	0.96 (0.45-2.04)	59.8	2.54 (1.22-5.26)*	2.91 (1.29-6.57)*
Obesity	37.5	1.00 (ref.)	1.00 (ref.)	37.0	1.00 (ref.)	1.00 (ref.)
Sleep						
<7 h/d	26.2	1.29 (0.77-2.15)	0.97 (0.49-1.92)	50.0	0.97 (0.63-1.49)	0.88 (0.53-1.48)
≥7 h/d	21.6	1.00 (ref.)	1.00 (ref.)	50.8	1.00 (ref.)	1.00 (ref.)
Media-screen time						
<2 h/d	19.0	0.76 (0.47-1.22)	0.83 (0.47-1.48)	36.8	0.41 (0.29-0.58)***	0.64 (0.42-0.99)*
2-4 h/d	20.9	0.85 (0.60-1.22)	0.92 (0.60-1.42)	50.1	0.71 (0.53-0.94)*	0.94 (0.67-1.31)*
≥4 h/d	23.6	1.00 (ref.)	1.00 (ref.)	58.7	1.00 (ref.)	1.00 (ref.)
Homework time						
<1 h/d	28.1	1.35 (0.76-2.39)	1.67 (0.83-3.37)	45.5	0.63 (0.37-1.05)*	0.46 (0.25-0.86)*
1-3 h/d	20.3	0.88 (0.55-1.41)	1.12 (0.62-2.02)	48.8	0.72 (0.53-0.97)*	0.66 (0.47-0.94)*
≥3 h/d	22.5	1.00 (ref.)	1.00 (ref.)	57.1	1.00 (ref.)	1.00 (ref.)
Number of daily meals & snacks						
≤3	25.5	1.35 (0.91-2.00)	0.77 (0.46-1.28)	50.9	1.11 (0.81-1.53)	1.08 (0.73-1.61)
4	20.6	1.02 (0.70-1.50)	0.70 (0.44-1.12)	52.7	1.20 (0.86-1.66)	1.14 (0.77-1.70)
≥5	20.2	1.00 (ref.)	1.00 (ref.)	48.2	1.00 (ref.)	1.00 (ref.)

Table 2. *Continued*

Variable	Boys: Sedentary adolescents (%)	Boys: Crude OR (95% CI) [a]	Boys: Adjusted OR (95% CI)[b]	Girls: Sedentary adolescents (%)	Girls: Crude OR (95% CI) [a]	Girls: Adjusted OR (95% CI) [b]
KIDMED index						
Poor –quality diet	25.5	1.58 (0.93-2.68)*	1.34 (0.70-2.56)*	67.3	3.19 (2.10-4.86)***	3.08 (1.83-5.17)***
Average –quality diet	24.5	1.50 (1.03-2.18)*	1.45 (0.93-2.26)*	52.2	1.69 (1.25-2.31)**	1.57 (1.10-2.23)*
Good –quality diet	17.8	1.00 (ref.)	1.00 (ref.)	39.2	1.00 (ref.)	1.00 (ref.)
Desire for weight change						
To be thinner	31.3	0.52 (0.03-1.26)*	0.23 (0.07-1.24)	50.7	0.89 (0.53-1.47)	0.77 (0.40-1.45)
To remain the same weight	13.0	0.50 (0.32-0.78)**	0.47 (0.28-0.79)**	50.1	0.87 (0.51-1.47)	0.80 (0.42-1.52)
To be thicker	23.0	1.00 (ref.)	1.00 (ref.)	53.7	1.00 (ref.)	1.00 (ref.)

Abbreviations: PA, physical activity; OR, odds ratio; CI, confidence interval; ref.: reference; KIDMED: Mediterranean Diet Quality Index. [a]Univariate analysis (logistic regression analysis considering the effect of one explanatory variable). [b]Multivariate analysis (multiple logistic regression analysis considering the simultaneous effect of all explanatory variables).*p<0.05; **p<0.01; ***p<0.001. NS: not significant.

Table 3. Anthropometric characteristics of the Balearic Islands' adolescents, according to physical activity practice and stratified by sex.

	Boys			Girls		
	Sedentary adolescents	**Active adolescents**	***P***	**Sedentary adolescents**	**Active adolescents**	***P***
n	207	732		519	503	
%	22.0	78.0		50.8	49.2	
Weight (kg)	65.1 ± 13.1	63.2 ± 13.0	NS	56.1 ± 11.0	57.8 ± 11.1	*
Height (cm)	169.5 ± 8.6	170.3 ± 8.7	NS	161.0 ± 6.6	160.8 ± 6.6	NS
BMI (kg/m^2)	22.5 ± 3.8	21.7 ± 3.8	**	21.6 ± 4.0	22.3 ± 3.8	**
WC (cm)	74.7 ± 8.6	72.9 ± 8.4	*	67.8 ± 8.2	68.6 ± 8.1	NS
HC (cm)	93.6 ± 9.9	91.6 ± 10.0	*	93.5 ± 9.9	95.0 ± 9.8	*
TSCF (mm)	11.7 ± 5.1	10.5 ± 5.1	**	15.3 ± 5.3	15.2 ± 5.3	NS
SCSF (mm)	12.1 ± 3.2	10.1 ± 5.9	***	12.9 ± 6.0	13.1 ± 6.0	NS
BF (%)	19.2 ± 4.6	16.5 ± 8.4	***	24.2 ± 6.4	24.1 ± 6.4	NS
FMI	4.7 ± 2.8	3.8 ± 2.8	***	5.4 ± 2.2	5.6 ± 2.3	NS
WHtR	0.5 ± 0.06	0.4 ± 0.05	**	0.4 ± 0.04	0.4 ± 0.04	NS

Abbreviations: BMI, body mass index; WC, waist circumference; HC, hip circumference; TSCF, tricipital skinfold thickness; SCSF, subscapular skinfold thickness; BF, body fat; FMI, fat mass index; WHtR, waist-to-height ratio.
Values are mean ± SD. Significant differences between sedentary and active adolescents by ANCOVA adjusted for age, parental socio-economic status, parental educational level, number of daily meals & snacks, and adherence to the Mediterranean diet.
**P*<0.05; ***P*<0.01; ****P*<0.001. NS: not significant.

Table 4. Food consumption among active and sedentary Balearic Islands' adolescents.

		Boys			Girls		
Food groups	**Frequency consumption**	**Active (%)** n=732	**Sedentary (%)** n=207	***P***	**Active (%)** n=519	**Sedentary (%)** n=503	***P***
Dairy products							
Milk†	≥7 t/w	77.2	76.8	0.906	67.6	64.5	0.333
Yogurt & cheese	≥7 t/w	68.4	62.4	0.123	64.5	56.1	0.009
Dairy desserts	≥2 t/w	71.5	72.2	0.863	61.9	62.9	0.763
Meat							
Red meat†	≥2 t/w	53.0	55.9	0.489	39.6	42.8	0.314
Poultry & rabbit†	≥2 t/w	15.6	14.4	0.698	17.7	21.3	0.171
Sausages†	≥5 t/w	54.9	56.2	0.754	46.5	48.1	0.644
	2-4 t/w	25.8	25.4	0.922	26.2	21.3	0.086
	≤4 t/m	19.3	18.4	0.774	27.3	30.6	0.271
Fish & seafood†	≥2 t/w	20.1	14.5	0.089	19.3	14.8	0.071
Eggs†	≥2 t/w	31.4	38.7	0.062	23.8	22.2	0.558
Legumes	≥2 t/w	20.8	19.8	0.772	19.3	18.3	0.685
Cereals, grains & products							
Bread†	≥7 t/w	86.5	82.8	0.201	82.9	81.1	0.475
Breakfast cereals†	≥5 t/w	47.1	36.6	0.011	34.7	26.4	0.006
Biscuits	≥5 t/w	25.7	14.0	0.019	23.8	20.5	0.378
Pasta†	≥5 t/w	8.7	8.0	0.778	6.6	5.8	0.603
Rice dishes†	≥5 t/w	8.7	9.1	0.860	6.6	7.0	0.789
Pizza†	≥2 t/w	19.9	14.4	0.093	11.4	12.8	0.525
Fruits							
Fresh fruits†	≥2/day	30.4	21.9	0.024	40.2	22.5	0.000
Fruit juices	≥7 t/w	54.0	46.5	0.074	52.3	45.7	0.046
Canned fruits	≥2 t/w	7.2	7.5	0.878	4.9	3.0	0.141
Vegetables†	≥2/day	8.2	7.5	0.748	11.5	13.2	0.415
Nuts†	≥2 t/w	36.2	31.0	0.193	23.3	25.1	0.533
Potatoes & tubercles†	≥2 t/w	42.0	44.9	0.471	32.1	32.1	0.990
Fats							
Olive oil	≥7 t/w	52.5	45.7	0.104	57.0	55.0	0.530
Others oils & fats	≥2 t/w	36.8	34.4	0.556	36.3	37.0	0.829
High fat foods	≥5 t/w	41.9	42.5	0.870	26.8	36.8	0.001
	2-4 t/w	29.0	23.8	0.167	29.0	29.4	0.905
	≤4 t/m	29.2	33.7	0.241	44.2	33.8	0.001
Drinks							
Soft drinks	≥5 t/w	55.4	55.4	0.986	32.0	44.6	0.000
	2-4 t/w	12.2	9.1	0.254	10.1	10.9	0.691
	≤4 t/m	32.4	35.5	0.429	57.9	44.4	0.000
Tea & coffee	≥2 t/w	15.1	12.4	0.363	14.2	18.7	0.069
Alcoholic beverages	≥1 t/w	11.1	9.6	0.561	4.2	5.4	0.427
Other foods							
Sweets	≥5 t/w	69.9	70.7	0.830	77.8	74.6	0.264
	2-4 t/w	16.4	13.8	0.408	12.8	16.2	0.152
	≤4 t/m	13.7	15.5	0.559	9.4	9.2	0.921
Chocolates	≥5 t/w	17.0	21.5	0.166	16.7	16.1	0.791
	2-4 t/w	12.2	13.3	0.697	10.9	12.2	0.537
	≤4 t/m	70.8	65.2	0.151	72.4	71.7	0.825

Abbreviations: t/w, times/week; t/m, times/month
†Food consumption cut-offs according to Lazarou et al.[31,32]. Significant differences between active and sedentary adolescents by χ^2 test.

Manuscrit VII

Body image and food consumption differences according to body composition among adolescents.

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Body image and food consumption differences according to body composition among adolescents

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Abstract

Background: People with greater relative weight usually underreported their food intake; specifically, overestimating the consumption of healthy food items and underestimating the consumption of unhealthy foods.

Aims: To assess the prevalence of overweight and obesity according to BMI and fat mass index (FMI) cut-offs for adolescents, and its association to adolescents' self-perception and attitudes toward weight control, as well as differences in food intake.

Methods: Cross-sectional nutritional survey carried out in the Balearic Islands (2007-2008). A random sample (*n*=1231) of the adolescent population (12-17 years old) was interviewed. Anthropometric measurements, questions related to self-perception and attitudes toward weight control, incorporating Stunkards' silhouettes, and dietary assessment based on a 145-item semi-quantitative food-frequency questionnaire were used. Adolescents were grouped according to BMI and FMI cut-offs. The association between the frequencies of consumption of various food groups and body composition taking into account body image (normal-fat v. overfat desiring to be thinner v. overfat satisfied) was also evaluated. Multiple logistic regression analysis was used to adjust for potential confounders.

Results: Adolescents were classified as following: 73.2% normal-weight normal-fat, 2.1% normal-weight overfat, 6.7% overweight normal-fat, 11.9% overweight overfat and 6.1% obesity. Normal-weight normal-fat adolescents and normal-weight overfat boys were the most satisfied with their body image. Body shape dissatisfaction increased according to overall and central adiposity increased. Most commonly desired Stunkards' silhouettes in boys and girls were 4 and 3, respectively. More than a half of overweight and obesity girls (62%) chose silhouette 4 as ideal. About 51% of boys and 60% of girls that desired to be thinner had ≤3 eating occasions per day. Multiple logistic regressions analysis showed that overfat boys desiring to be thinner were less likely to eat frequently red meat, pasta & rice dishes, other oils & fats and soft drinks; and dairy desserts and chocolates among girls.

Conclusions: Body shape dissatisfaction increase with adiposity. As obesity category increased, the silhouettes chosen by boys and girls also increased in size. Body shape satisfaction among overweight and obese adolescents is related to meal patterns and food choices.

Keywords: BMI, FMI, body image, adolescents, food intake.

Introduction

The prevalence of overweight and obesity among children and adolescents has increased dramatically worldwide [1,2]. The current literature suggests as main risk factors for overweight and obesity a decrease in levels of physical activity as well as an increase in sedentary activities combined with changes in the quality and quantity of diets. However, controversial results between food consumption and overweight and obesity status have been reported. While some epidemiological studies have shown a positive relationship between fast-food and sweetened beverage consumption and overweight and obesity status [3-5]; others had not [6,7]. It has been well documented that people with greater relative weight usually underreported their food intake [8]; the lack of statistical significance could be attributed to an overestimation of the consumption of healthy food items and an underestimation of the consumption of unhealthy foods. However, beauty patterns are also factors that have a strong influence on eating habits [9].

Adolescence is a transitional stage and many changes take place at physiologic and behavioral levels, increasing also the evaluation of body and appearance in this period. Body image is a multidimensional construct central to emotional well-being in which the attitudinal component is satisfaction with body size, a factor associated with self-esteem [10]. Body dissatisfaction is a prevalent reality for many adolescents, in which the rapid bodily development resulting from puberty sometimes difficult task of accepting one's body changes.

Achieving a reliable and accurate estimation of body fatness is essential among adolescents, not only for the prevention and the treatment of an unfavourable metabolic profile but also to evaluate one's appearance. However, in most of population-based studies have been used BMI despite that the acknowledgement that is not useful tool to identify overweight and obesity.

The aim of the study was to assess the prevalence of overweight and obesity according to BMI and fat mass index (FMI) cut-offs for adolescents, and its association to adolescents' self-perception and attitudes toward weight control, as well as differences in food intake.

Material and methods

Study design

The study is a population-based cross-sectional nutritional survey carried out in the Balearic Islands between 2007 and 2008.

Selection of participants, recruitment and approval

The target population consisted of all inhabitants living in the Balearic Islands aged 12-17 years. The sample population was derived from residents aged 12-17 years registered in the scholar census of the Balearic Islands. The theoretical sample size was set at 1500 individuals in order to provide a specific relative precision of 5% (type I error=0.05; type II error=0.10), taking into account an anticipated 70% participation rate. The sampling technique included stratification according to municipality size, age, and sex of inhabitants, and randomisation into subgroups, with Balearic Islands municipalities being the primary sampling units, and individuals within the schools of these municipalities comprising the final sample units. The interviews were performed at the schools. The final sample size was 1231 individuals (82% participation). The reasons to not participate were: (a) the subject declined to be interviewed; (b) the parents did not authorize the interview.

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.

Anthropometry measurements

Height was determined using a mobile anthropometer (Kawe 44444, Asperg, Germany) to the nearest millimetre, with the subject's head in the Frankfurt plane. Body weight was determined to the nearest 100g using a digital scale (Tefal, sc9210, Rumilly, France). The subjects were weighed in bare feet and light underwear, which was accounted for by subtracting 300g from the measured weight. Triceps and subscapular skinfold thickness were measured using a Holtain skinfold calliper (Tanner/Whitehouse, Crosswell, Crymych, UK), and the mean of three measurements (right arm) was used [11]. Height and weight measures were used to calculate BMI (kg/m^2). Body fat (BF) was measured from tricipital and subscapular skinfold thickness according to Slaughter et al [12]. This equation has been proposed as the most accurate for estimation of body percentage from skinfold thickness in this particular population of adolescents [13]. BF and height were used to calculate FMI (kg/m^2). The subjects were asked to stand erect in a relaxed position with both feet together on a flat surface.

Defining overweight and obesity

In children and adolescents, the BMI for age has been established as the main measurement to define overweight and obesity [14]. However, there are some limitations associated with their use as indicators of fatness. Thus, individuals with increased muscle mass may also have increased BMI [15]. On the other hand, individuals with decreased lean body mass and increased adiposity may also be misclassified by assessment with BMI [15]. Alvero-Cruz et al. [16] showed that the FMI had high accuracy for overweight screening that BMI. The FMI is a useful measure to evaluate body composition parameters by effectively eliminating differences in body fat associated with height [17]. Nevertheless, it is difficult to exclude BMI from the normal-weight and overweight definition. For this reason, a combination of BMI and FMI was used to define overweight and obesity in the present study.

Subjects were age- and sex-specific classified using the cut-offs developed and proposed for international comparisons by Cole et al. [18], recommended by IOTF, and then subjects were classified as normal-fat and overfat according to their FMI using the sex-specific cut-offs proposed by Alvero-Cruz et al. [16] for adolescents: 4.58 kg/m^2 in boys and 7.76 kg/m^2 in girls. Thus, adolescents were classified into five weight and fat groups as following:

1) Normal-weight normal-fat (BMI for age and sex <25 kg/m^2; FMI<4.58 kg/m^2 in boys, FMI<7.76 kg/m^2 in girls)
2) Normal-weight overfat (BMI for age and sex <25 kg/m^2; FMI≥4.58 kg/m^2 in boys, FMI≥7.76 kg/m^2 in girls)
3) Overweight normal-fat (BMI for age and sex ≥25-BMI-<30 kg/m^2; FMI<4.58 kg/m^2 in boys, FMI<7.76 kg/m^2 in girls)
4) Overweight overfat (BMI for age and sex ≥25-BMI-<30 kg/m^2; FMI≥4.58 kg/m^2 in boys, FMI≥7.76 kg/m^2 in girls)
5) Obesity (BMI for age and sex ≥30 kg/m^2).

Body image

Estimation of their own weight. The subjects were asked to estimate their current height and weight prior to measurement. Estimates within 2 kg of real weight were classified as correct; 2 kg or under real weight was considered an underestimate and 2 kg or more than real weight was considered an overestimate.

Acceptance of one's silhouette. Perceived body image was measured using a scale of body figures developed by Stunkard et al. [19] modified. The Stunkard scale consists of silhouette drawings ranging from 1 to 9 with monotonic increments in overweight percentage where 1 is the leanest and 9 is the heaviest. Separate figures for boys and girls were used. Participants were asked to identify of the 9 body figures: (a) 'Which silhouette looks most like yourself?' and (b) 'Which silhouette would you like to look like?' The difference between perceived body image and desired body image was used to determine the level of dissatisfaction with current body image. Values other than zero represent dissatisfaction with perceived body image. A positive value was indicative of the participant's desire to be smaller than his/her perceived current size while a negative value reflected the participant's desire to be larger than his/her current perceived size [20,21].

Attitudes towards their own weight. The subjects responded the question "Do you consider yourself as obese?" (yes; no) and "Are you worried about weight gain?" (A lot; A little; No).

Behaviours about weight. The subjects responded to the question: "have you ever tried to lose weight?" (Yes; No) and "If you answered yes, have you done so by: dieting, physical activity dieting and physical activity, other".

Dietary assessment

A semi-quantitative food-frequency questionnaire (FFQ) previously validated [22] and applied to other studies and surveys over the Spanish population [23-27] was used. 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 food consumption (g/d) was determined by dividing the reported amount (g) of food consumed by the frequency of intake (day, week –divided by 7-, or month –divided by 30-). The period of consumption of seasonal items was also considered. Edible fractions of foods were recorded in the database

[22,23,27]. The FFQ foods items were collapsed to twenty-eight food groups (Table 4) that may have practical importance in daily diet and closely approximated food groups previously reported [28,29].

Well-trained dieticians administered, verified and quantified all dietary questionnaires. To estimate volumes and portion sizes, the household measures found in the subjects' own homes were used. Conversion of food into nutrients was done using a computer program (ALIMENTA®, NUCOX, Palma, Spain) based on Spanish [30,31] and European [32] food composition tables and complemented with food composition data available for Majorcan food items [33]. Identification of mis-reports: An energy intake (EI)/basal metabolic rate (BMR) ratio <0.92 (men) and <0.85 (women) was considered to represent under reporting [34], and an EI:BMR≥2.4 as over reporting [35,36]. Underreporters (20%) and overreporters (2%) were excluded from the analysis of dietary patterns.

Assessment of meal patterns

The number of daily meals and snacks was calculated from the total eating occasions that participants declared among the following: breakfast; mid-morning snack; lunch; mid-afternoon snack; dinner; before going to sleep; others. Three groups of eating frequency were considered: ≤3, 4 and ≥5 times/d. Information about breakfast habit (yes; occasionally; no) was also collected.

Assessment of Mediterranean diet patterns

The quality of diet by the compliance with MD was evaluated using the KIDMED index (Mediterranean diet quality index for children and adolescents), described elsewhere [37]. Based on the given answers, the test classified individuals according to the quality of the MD categorized as: optimal quality, mid-quality/needs-improvements and low quality.

Assessment of other co-variables

Sociodemographic variables

A questionnaire incorporating the following questions was used: age group; parental educational level (according to years and type of education: low, <6 years; medium, 6-12 years; high, >12 years); parental socio-economic level (based on the occupation of parents and classified as low, medium and high, according to the Spanish Society of Epidemiology [38].

Assessment of physical activity

Physical activity was evaluated according to the guidelines for data processing and analysis of the international physical activity questionnaire (IPAQ) [39] in the short form and its specific modification for adolescents (IPAQ-A) [40]. The specific types of activity assessed were walking, moderate-intensity activities (i.e. physical activity at school), and vigorous-intensity activities (i.e. sport practice). In accordance with the AVENA (Food and Assessment of Nutritional Status of Adolescents) study [41], the questionnaire also included information on television (TV) viewing and computer use and video games in h/d to the nearest 10 min. Physical inactivity was established with a cut-off level of 300 min/week of moderate/vigorous physical activity, in accordance with recent reports of physical activity for adolescents [42].

Statistics

Analyses were performed with Statistical Package for the Social Sciences version 19.0 (SPSS, Inc., Chicago, IL, USA). Significant differences in prevalence were calculated by means of χ^2. We further applied multiple logistic regression analysis evaluating the association between body composition taking into account body image (normal-fat v. overfat desiring to be thinner v. overfat satisfied) with the frequencies of consumption of several food groups adjusted for potential confounders (age, parental educational level, parental socio-economic status, breakfast habit, number of daily meals and snacks, media screen time and physical activity). Level of significance for acceptance was $P<0.05$.

Results

Prevalence of normal-weight, overweight and obesity according to BMI and FMI

Table 1 shows the prevalence of normal-weight, overweight and obesity (BMI) according to overall adiposity (FMI). Thus, the three body weight groups obtained by IOTF cut-offs (normal-weight, overweight and obesity) were subgrouped according to presence or absence of overfat. Adolescents were classified into five groups as following: 73.2% normal-weight normal-fat, 2.1% normal-weight overfat, 6.7% overweight normal-fat, 11.9 % overweight overfat and 6.1% obesity.

Adolescents' self-perception and attitudes toward weight control

Adolescents' body dissatisfaction according to the proposed classification was also analyzed using the Stunkard's standard silhouettes (Figures 1 and 2). Overall, while boys were more likely to desire a silhouette 4 as ideal, girls were more likely to report a silhouette 3 as ideal. However, results also showed that more than a half of overweight overfat (68.1%) and obesity (55.6%) girls identified the silhouette 4 as ideal. On the other hand, 21.3% of normal-weight normal-fat girls preferred to look as silhouette 2.

Self-perception and the consciousness and attitude toward the current weight and fat were also assessed (Table 2). In boys, the percentage of subjects that correctly estimated their weight decreased especially in the overweight overfat (34.8%) and obesity (11.8%) groups. In the overweight overfat group, almost 2 of 10 boys reported to be satisfied with their body shape, being this prevalence of 3% in the obesity group. Normal-weight normal-fat boys were the most satisfied with their body shape (46.6%) and in this group, while 26.8% of boys reported to desire a thinner body shape, 73.2% of them reported to desire a larger one's. In normal-weight overfat and overweight normal-fat group about 6 of 10 subjects reported to be unsatisfied with their body shape.

Despite that a high percentage of overweight overfat and obesity boys reported to desire a thinner body shape, most of them did not perceive themselves as obese (80.4% and 64.5%, respectively). Overweight overfat and obesity groups were the most worried about weight gain (60.9% and 75%, respectively). Boys who reported to have ever tried to lose weight also were those classified into the overweight overfat and obesity groups (67.4% and 77.4%, respectively), although almost 4 of 10 normal-weight overfat boys also attempted to lose weight sometimes. Methods to attempt losing weight were also evaluated and no differences were found between groups among boys.

In girls, since the prevalence of normal-weight overfat was only 0.5% this group was not considered in this analysis. Results showed that body dissatisfaction and desire to have a thinner body shape increased across groups. Around 3 of 10 overweight normal-fat girls perceived themselves as obese and about 62% reported to be worried about weight gain. Around 8 of 10 overweight normal-fat girls were worried about weight gain. Finally, more than a half of normal-weight normal-fat girls reported to have attempted to lose weight sometimes, being higher this percentage in the other groups. Results also showed that obese girls attempted to lose weight more often by the combination of diet and physical activity and were less likely to try it by physical activity than their leaner counterparts.

Meal patterns of participants according to body composition and body image

Table 3 shows associations between meal patterns and body composition taking into account satisfaction with own body shape (normal-fat v. overfat desiring to be thinner v.

overfat satisfied). It is important to note that most of overfat girls (96.6%) desired to be thinner and an inverse association with number of daily meals and snacks and breakfast habit was found in them. Overfat boys that desired a thinner body shape (82.8%) also were more likely to had ≤3 eating occasions per day (50.8%).

Associations between body composition taking into account body image and intake of various food groups

Body image could be associated with food consumption. Then, associations between the frequencies consumption of various food groups and individual items and body composition taking into account satisfaction with own body shape (normal-fat v. overfat desiring to be thinner v. overfat satisfied) were also evaluated (Table 4). The results showed that overfat adolescents (37%) mis-reported their EI more often than normal-fat adolescents (10%). When only adolescents who did not mis-reported their EI were used for analysis, we found that overfat boys who desired to be thinner had a significant lower EI (2175 kcal/d, SD 645.7) than overfat adolescents satisfied with their body shape (2783 kcal/d, SD 647.5) and normal-fat adolescents (2581 kcal/d, SD 645.5). Moreover, overfat boys desiring to be thinner also had significant lower energy from saturated fat acids (12.6%, SD 3.6) than normal-fat boys (13.8%, SD 3.6). In girls, no significant difference in EI was found between normal-fat (2047 kcal/d, SD 532.0) and overfat (1952 kcal/d, SD 532.1) adolescents who desired to be thinner.

Parallel to differences in EI, we also found that overfat boys that desired to be thinner were less likely to consume breakfast cereals, pasta & rice dishes, other oils & fats, high fat foods, soft drinks and chocolates than their satisfied and normal-fat counterparts. Compared with normal-fat girls, those overfat girls also consumed less frequently dairy desserts and chocolates.

After applying multiple logistic regression analysis in order to control for various potential confounders (i.e. age, parental educational level, parental socio-economic status, breakfast habit, number of daily meals and snacks, physical activity and media screen time) and estimate the size of any observed differences, several differences with respect to the bivariate analysis were found in boys but not in girls. Specifically, overfat that desired to be thinner were less likely to eat frequently red meat, pasta & rice dishes and other oils & fats than their satisfied and normal-fat counterparts. It should be noted that after the application of multiple logistic analysis, not only soft drinks association disappeared but also breakfast cereals, high fat foods and chocolates.

Discussion

The use of BMI for age to define being overweight and obesity in children and adolescents is well established for both clinical and public health applications [43,44]. However, it has been recognized that elevation of BMI does not always equate to increased adiposity because it does not distinguish between body fat mass and lean body mass [45], as well as the FMI has high accuracy for overweight screening [16]. However, it is difficult to exclude BMI from the normal-weight and overweight definition. Thus, the first aim of the present work was to assess the prevalence of overweight and obesity among the Balearic Islands' adolescent population combining BMI and FMI.

Using the proposed body weight and fat classification, 73.2% of adolescents were classified as normal-weight normal-fat, 2.1% as normal-weight overfat, 6.7% as overweight normal-fat, 11.9% as overweight overfat and 6.1% as obese. Prevalence of normal-weight overfat was higher among boys (4%) than girls (0.5%), and prevalence of overweight normal-fat was higher among girls (9.3%) than boys (3.6%). Whereas IOTF cut-offs are good proxies for normal-weight in girls, among boys FMI should be also measured to identify those boys who are normal-weight and have excess body fat. Among overweight adolescents by BMI, FMI should be assessing in both overweight boys and girls to reduce misclassification in this group. In spite of obesity prevalence could be underestimated using IOTF cut-offs [46-48], our results suggest that because in the obesity group almost all adolescents were overfat and they also showed significant higher means for perimeters, skinfolds thickness, BF and FMI than their counterparts, a cut-off BMI≥30 kg/m^2 for age and sex [18] could be adequate for obesity screening.

It has been also recognized that to be worried about body image is especially acute in puberty [49], but also that body image is an important target of intervention to improve subjective health in adolescence [50]. Most of previous studies in adolescents have analyzed differences in perception of body image and weight concerns according to gender [50], ethnic and social differences [51], and overweight and obesity status which has demonstrated that BMI is positively related to body dissatisfaction [52-54]. However, it has been indicated previously that BMI has some limitations as indicator of fatness. Thus, the second aim of the present work was to assess body image among adolescents taking into account not only normal-weight, overweight and obesity but also normal-weight with excess body fat (normal-weight overfat) and overweight without excess body fat (overweight normal-fat). The observed increase in anthropometric measurements across the proposed groups could be useful to assess differences in body image associated to adiposity rather than to BMI.

Sex and obesity has been extensively associated with body image problems. However, in agreement with emerging literature we observed that boys also suffer body image disturbances [55]. Despite that both male and female attractiveness standards espouse slenderness and denigrate overweight, not being adolescents an exception [56]; most of literature about body size satisfaction reported that levels of body dissatisfaction among boys are lower than among girls [50,57]. However, it is important to emphasize that gender differences in levels of body dissatisfaction among adolescents may be related to the used measurement method [55,58]. The studies that found higher levels of body dissatisfaction among girls than boys have been primarily focused on the desire to be smaller and strategies to lose weight [50,57]. However, when questionnaires to evaluate body image included the desire to want a larger body, similar level of body dissatisfaction for both boys and girls has been found [55,58]. Thus, in our study differences in satisfaction with body shape was only found in the overweight normal-fat group (36.8% boys vs. 11.3% girls). It is important to note that boys and girls perceive their bodies in a different way [51]. It has been extensively reported that the current ideal male body is lean but highly muscular, characterised by a “well-developed chest and arms, with wide shoulders tapering down to a narrow waist” [57]. Thus, whereas boys with lower BMI and %BF preferred a stronger muscular body, girls showed a preference for a slim body shape [51,53]. However, boys with elevated adiposity also showed a preference for a slim body shape. In fact, boys with elevated adiposity have been most likely to have negative feelings about their bodies [52].

The analysis of the ideal size using the Stunkard’s standard silhouettes showed that the most commonly silhouette chose by boys as the preferred body shape was the silhouette 4; while in girls was the silhouette 3. These results support the idea already mentioned above: whereas boys tend to desire a lean but highly muscular body shape, girls prefer a slim body shape than they have. However, the fact that overweight and obesity girls commonly chose a ledger silhouette than their leaner counterparts could be related to a conformity to a bigger body shape but still lower than the perceived. Despite that adolescents denigrate overweight and obesity, a decrease in body dissatisfaction has been suggested in recent studies among young people [56].

Despite that a high prevalence of both boys and girls were not concerned about their obesity status, which was more prevalent among boys than girls, a high preoccupation with weight [53] and attempting to lose weight sometimes [54] was observed in them. Moreover, to be worried about weight gain and attempts to lose weight increased was especially common in overweight overfat and obesity groups; as well as in the overweight normal-fat girls and normal-weight overfat boys. It has been suggested that whereas adolescents who are heavy and perceive themselves as overfat may have actively tried to lose weight [54], those adolescents who do not perceive themselves as heavy raise concerns may be less motivated to take steps to lose weight [59]. Finally, in agreement with the literature, while girls who had tried to lose weight were more likely to adopt strategies in order to lose weight, mainly by diet, or combining diet and physical activity in obese girls; boys were more likely to pursue strategies to increase their body weight and muscle mass [53,58,60].

During adolescence, individual freedom and independence from parents increased, as well as access to food resources different from those available at home, social interactions and the sub-cultural importance of specific foods [61]. However, while some epidemiological studies have shown a positive relationship between fast-food and sweetened beverage consumption and overweight and obesity status [3-5]; others have not [6,7]. Previously, we reported that normal-fat boys were more likely to follow a Western dietary pattern than a Mediterranean dietary pattern [62]. We also observed that desire for a thinner body shape was associated with a low risk for the Western dietary pattern in both boys and girls [62]. In the present study, we have observed that overfat boys desiring a thinner body reported a lower consumption of several food groups (i.e. breakfast cereals, pasta & rice dishes, other oils & fats, high fat foods, soft drinks and chocolates) identified previously in the Western dietary pattern [62]. Overfat girls also reported lower consumption of dairy products and chocolates, both also identified in the Western dietary pattern [62]. We have also previously observed that both boys and girls avoided sweets and salty snacks consumption to counteract the obesity [63].

Previously, we also reported an inverse association between obesity and the number of daily meals, which was observed in both boys and girls [63]. We also detected a greater risk to be obese in adolescents that do not have breakfast [63]. In the present study, overfat girls and overfat boys desiring to be thinner also were more likely to declare ≤3 eating occasions per day. Thus, omission of meals may be a method to self-control body weight in overfat girls and overfat dissatisfied boys.

Parallel to the omission of meals, it may be possible that overfat adolescents that desired to be thinner avoided several food groups consumption to counteract the overfat. However, it should be noted that we cannot ignore that the lower consumption of typical food groups of a Western-type diet among those overfat boys desiring to be thinner compared to normal-fat and overfat satisfied boys could be attributed to an overestimation of the healthy foods consumption and underestimation of the unhealthy foods consumption, because it has been well documented that people with greater relative weight usually underreported their food intake [8]. In this face, the lack of association between body composition and food consumption and food patterns observed in girls [62] could also be attributed that body image affects both normal-fat and overfat and may mask a real association in food consumption.

Nevertheless, our results support that body image is an especially strong determinant of adolescent nutritional habits and food choices [64]. Understanding of how body shape satisfaction affects meal patterns, food preferences and the overall adolescent diet is a key issue for the development of strategies aimed at influencing dietary behaviour.

Limitations of the study

Body fat was calculated using Slaughter et al. equations [12] which have been previously suggested [13]. However, our study did not take into account pubertal development despite that chronological age may vary dramatically during this phase. Therefore, as in a previous study [65] in which adolescents have been classified according to their pubertal stage, boys were divided into two groups: pubertal (12 to 14 years old) and post-pubertal (15 to 17 years old).

Conclusions

This study did not have the ambition to create a standard classification system for overweight and obesity. Rather, the findings showed here try to serve as groundwork and stimulus to establish international healthy ranges of adiposity in adolescence that could also assess accurately body image. Despite that body shape dissatisfaction increase with adiposity increasing, a ledger silhouette chose as ideal in overweight and obesity girls has been observed. Moreover, body shape satisfaction among overfat adolescents has been related to nutritional habits and food choices. Some researches have argued that some level of body dissatisfaction may be beneficial for individuals with average or above-average weight, as it may lead to healthy weight management behaviours such as increased intake of fruits and vegetables and regular physical activity [9,66,67]. Therefore, body image should be included in epidemiological studies and in prevention, control and intervention programs of overweight and obesity adolescents.

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Authors' contributions

MMB, JP and JAT conceived, designed, devised and supervised the study, MMB, JP and JAT collected and supervised the samples. MMB and JAT analysed the data and wrote the manuscript. AP and JAT obtained funding. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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Table 1. Prevalence (%) of normal-weight, overweight and obesity according to body weight (BMI) and adiposity (FMI) among adolescents' boys and girls from the Balearic Islands, Spain, 2007-2008[1]

Categories	Cut-offs	Total (*n*=1,231)	Boys (*n*=574)	Girls (*n*=657)
Normal-weight	BMI-for age and sex <25 kg/m^2			
Normal-fat	Boys: FMI<4.58 kg/m^2 Girls: FMI<7.76 kg/m^2	73.2	68.3	77.4
Overfat	Boys: FMI≥4.58 kg/m^2 Girls: FMI≥7.76 kg/m^2	2.1	4.0	0.5
Overweight	BMI-for age and sex ≥25-<30 kg/m^2			
Normal-fat	Boys: FMI<4.58 kg/m^2 Girls: FMI<7.76 kg/m^2	6.7	3.6	9.3
Overfat	Boys: FMI≥4.58 kg/m^2 Girls: FMI≥7.76 kg/m^2	11.9	17.6	7.1
Obesity	BMI-for age and sex ≥30 kg/m^2	6.1	6.5	5.8

[1]Values are %.
Abbreviations: BMI, body mass index; FMI, fat mass index.

Table 2. Body self-perception and attitudes toward weight-control practices of adolescents according to the weight and fat groups[1]

	Boys						**Girls**				
	Normal-weight		**Overweight**		**Obesity (*n*=37)**	***P***	**Normal-weight[2]**	**Overweight**		**Obesity (*n*=38)**	***P***
Body image	**Normal-fat (*n*=392)**	**Overfat (*n*=23)**	**Normal-fat (*n*=21)**	**Overfat (*n*=101)**			**Normal-fat (*n*=508)**	**Normal-fat (*n*=61)**	**Overfat (*n*=47)**		
Estimation of current weight											
Underestimation (%)	14.1	9.5	15.8	5.4	2.9	0.079	7.5	5.7	2.1	0.0	0.261
Correct (%)	54.1	52.4	52.6	34.8	11.8	0.000	64.2	41.5	33.3	25.0	0.000
Overestimation (%)	21.1	23.8	31.6	48.9	55.9	0.000	18.9	32.1	50.0	50.0	0.000
Unconscious (%)	10.7	14.3	0.0	10.9	29.4	0.010	9.4	20.8	14.6	25.0	0.008
Satisfaction with current body weight											
Yes (%)	46.6	38.1	36.8	16.5	3.0	0.000	42.9	11.3	6.4	0.0	0.000
No (%)	53.4	61.9	63.2	83.5	97.0	0.000	57.1	88.7	93.6	100.0	0.000
Desire for weight change											
Wants thinner body (%)	14.3	61.9	52.6	82.4	97.0	0.000	47.8	88.7	93.6	100.0	0.000
Remain the same (%)	46.6	38.1	36.8	16.5	3.0	0.000	42.9	11.3	6.4	0.0	0.000
Wants larger body (%)	39.1	0.0	10.5	1.1	0.0	0.000	9.3	0.0	0.0	0.0	0.007
Do you consider yourself as obese?											
Yes (%)	0.9	14.3	0.0	19.6	35.5	0.000	5.3	28.0	37.5	61.1	0.000
No (%)	99.1	85.7	100.0	80.4	64.5	0.000	94.7	72.0	62.5	38.9	0.000
Are you worried about weight gain?											
A lot (%)	3.4	14.3	0.0	12.0	12.5	0.002	17.3	27.5	37.5	41.7	0.000
A little (%)	19.5	14.3	44.4	48.9	62.5	0.000	44.4	54.9	50.0	44.4	0.649
No (%)	77.1	71.4	55.6	39.1	25.0	0.000	38.3	17.6	12.5	13.9	0.000
Have you ever tried to lose weight?											
Yes (%)	17.8	38.1	33.3	67.4	77.4	0.000	58.1	86.3	83.3	97.2	0.000
No (%)	82.2	61.9	66.7	32.6	22.6	0.000	41.9	13.7	16.7	2.8	0.000
How have you tried to lose weight?											
Diet	6.3	12.5	0.0	16.1	16.7	0.366	28.1	36.4	45.0	31.4	0.248
Physical activity	65.1	75.0	50.0	45.2	41.7	0.092	32.5	27.3	20.0	2.9	0.002
Diet and physical activity	27.0	12.5	50.0	38.7	41.7	0.290	38.7	36.4	35.0	65.7	0.015
Other	1.6	0.0	0.0	0.0	0.0	0.809	0.7	0.0	0.0	0.0	0.924

[1]Values are %. Significant trends in the weight and fat groups evaluated by χ^2.
[2]Since the prevalence of normal-weight overfat was only 0.5% (n=3) this group was not considered in this analysis.

Table 3. Meal patterns by body composition taking into account body image among adolescents' boys and girls from the Balearic Islands, Spain, 2007-2008[1]

	Boys				Girls[2]		
	Normal-fat (*n*=412)	**Overfat dissatisfied[3] (*n*=134)**	**Overfat satisfied[4] (*n*=28)**	***P***	**Normal-fat (*n*=564)**	**Overfat dissatisfied[3] (*n*=90)**	***P***
Breakfast habit							
Yes	79.1	69.7	79.2	0.164	64.6	43.4	0.001
Occasionally	13.8	16.0	12.5		19.5	30.1	
No	7.2	14.3	8.3		15.9	26.5	
Number of daily meals & snacks							
≤3	18.9	50.8	21.7	0.000	41.7	60.2	0.006
4	35.6	37.3	43.5		33.3	20.5	
≥5	45.6	11.9	34.8		25.3	19.3	

[1]Values are %. Significant differences between groups were evaluated by χ^2.
[2]Since the prevalence of overfat satisfied with own body shape was only 0.5% (n=3) this group was not considered in this analysis.
[3]Overfat desiring to be thinner and [4]overfat satisfied with own body shape.
Only adolescents who did not mis-report their EI were considered for this analysis.

Table 4. Food consumption by body composition taking into account body image among adolescents' boys and girls from the Balearic Islands, Spain, 2007-2008[1]

		Boys				Girls[2]		
Food groups	**Frequency categories**	**Normal-fat (*n*=412)**	**Overfat dissatisfied[3] (*n*=134)**	**Overfat satisfied[4] (*n*=28)**	***P***	**Normal-fat (*n*=564)**	**Overfat dissatisfied[3] (*n*=90)**	***P***
Dairy products								
Milk†	≥7 t/w	79.9	76.5	76.5	0.788	66.4	55.3	0.128
Yogurt & cheese	≥7 t/w	67.1	64.7	70.6	0.879	62.4	59.6	0.700
Dairy desserts	≥2 t/w	77.2	77.9	82.4	0.880	65.2	46.8	0.013
Meat								
Red meat†	≥2 t/w	56.3	41.8	64.7	0.067	44.8	34.8	0.193
Poultry & rabbit†	≥2 t/w	15.2	14.7	11.8	0.925	14.8	13.0	0.751
Sausages†	≥5 t/w	52.4	52.2	58.8	0.874	47.6	45.7	0.804
	2-4 t/w	27.4	28.4	29.4	0.975	25.2	19.6	0.401
	≤4 t/m	20.1	19.4	11.8	0.699	27.3	34.8	0.279
Fish & seafood†	≥2 t/w	17.4	25.4	17.6	0.317	15.7	6.5	0.096
Eggs†	≥2 t/w	36.5	34.3	29.4	0.811	22.4	23.9	0.816
Legumes	≥2 t/w	19.7	22.1	5.9	0.317	17.5	10.6	0.234
Cereals, grains & products								
Bread†	≥7 t/w	84.8	88.2	88.2	0.727	82.1	83.0	0.877
Breakfast cereals†	≥5 t/w	53.3	35.3	47.1	0.028	30.1	31.9	0.799
Biscuits	≥5 t/w	22.8	17.6	17.6	0.594	23.0	14.9	0.205
Pasta & rice dishes	≥5 t/w	22.8	11.8	35.3	0.048	15.6	25.5	0.083
Pizza†	≥2 t/w	18.7	10.3	11.8	0.213	11.0	14.9	0.429
Fruits								
Fresh fruits†	≥2/day	30.1	32.4	29.4	0.932	30.8	31.9	0.876
Fruit juices	≥7 t/w	54.0	44.1	52.9	0.341	50.6	51.1	0.949
Canned fruits	≥2 t/w	9.3	10.3	5.9	0.855	4.8	6.4	0.641
Vegetables†	≥2/day	7.3	7.4	5.9	0.976	12.9	14.9	0.696
Nuts†	≥2 t/w	39.4	32.4	41.2	0.538	24.8	23.4	0.830
Potatoes & tubercles†	≥2 t/w	42.9	47.1	41.2	0.807	33.3	29.8	0.623
Fats								
Olive oil	≥7 t/w	51.7	41.8	47.1	0.333	54.0	52.2	0.809
Others oils & fats	≥2 t/w	41.0	23.9	35.3	0.033	36.7	30.4	0.399
High fat foods	≥5 t/w	49.7	31.3	47.1	0.026	38.1	26.1	0.108
	2-4 t/w	24.3	32.8	41.2	0.138	28.4	32.6	0.550
	≤4 t/m	26.0	35.8	11.8	0.093	33.5	41.3	0.288
Drinks								
Soft drinks	≥5 t/w	59.4	40.3	52.9	0.018	41.8	43.5	0.827
	2-4 t/w	10.8	11.9	17.6	0.672	11.1	6.5	0.340
	≤4 t/m	29.9	47.8	29.4	0.019	47.1	50.0	0.709
Tea & coffee	≥2 t/w	10.8	13.4	23.5	0.258	16.7	13.0	0.527
Alcoholic beverages	≥1 t/w	8.9	5.9	11.8	0.637	3.7	4.3	0.845

Table 4. *Continued*

		Boys				Girls[2]		
Food groups	**Frequency categories**	**Normal-fat (*n*=412)**	**Overfat dissatisfied[3] (*n*=134)**	**Overfat satisfied[4] (*n*=28)**	***P***	**Normal-fat (*n*=564)**	**Overfat dissatisfied[3] (*n*=90)**	***P***
Other groupings								
Sweets	≥5 t/w	73.6	73.1	64.7	0.723	79.2	67.4	0.067
	2-4 t/w	14.6	11.9	17.6	0.787	13.0	19.6	0.214
	≤4 t/m	11.8	14.9	17.6	0.642	7.9	13.0	0.228
Chocolates	≥5 t/w	21.9	9.0	41.2	0.006	19.9	8.7	0.065
	2-4 t/w	11.5	13.4	5.9	0.681	11.8	6.5	0.284
	≤4 t/m	66.7	77.6	52.9	0.088	68.4	84.8	0.021
KIDMED index scores								
Low quality diet (0-3)		10.4	11.9	29.4	0.057	17.9	19.6	0.784
Mid-quality diet (4-7)		58.7	52.2	35.3	0.122	57.0	52.2	0.529
Optimal quality diet (8-12)		30.9	35.8	35.3	0.702	25.1	28.3	0.635

Abbreviations: t/w, times/week; t/m, times/month.
[1]Values are %. Significant differences between groups were evaluated by χ^2.
[2]Since the prevalence of overfat satisfied with own body shape was only 0.5% (n=3) this group was not considered in this analysis.
[3]Overfat desiring to be thinner and [4]overfat satisfied with own body shape.
†Food consumption cut-offs according to Lazarou et al. [28,29]
Only adolescents who did not mis-report their EI were considered for this analysis.

Table 5. Odds ratios and 95% CI, derived from multiple logistic regression analysis, showing the association between body composition taking into account body image and adolescents' consumption of selected food groups

		Overfat desiring thinner body v. overfat satisfied and normal-fat	
Food groups	**Frequency categories**	**Boys**	**Girls**[1]
Dairy products			
Milk†	≥7 t/w v. <7 t/w (ref.)	0.49 (0.19-1.29)	0.98 (0.41-2.34)
Yogurt & cheese	≥7 t/w v. <7 t/w (ref.)	1.39 (0.62-3.12)	1.04 (0.43-2.50)
Dairy desserts	≥2 t/w v. 2 t/w (ref.)	2.39 (0.92-6.18)	0.30 (0.13-0.70)**
Meat			
Red meat†	≥2 t/w v. 2 t/w (ref.)	0.35 (0.16-0.79)*	0.64 (0.27-1.53)
Poultry & rabbit†	≥2 t/w v. 2 t/w (ref.)	1.93 (0.58-6.47)	0.80 (0.23-2.75)
Sausages†	≥5 t/w v. ≤4 t/m (ref.)	1.61 (0.60-4.32)	1.12 (0.46-2.74)
	2-4 t/w v. ≤4 t/m (ref.)	1.57 (0.57-4.35)	0.67 (0.23-1.98)
	≤4 t/m (ref.)		
Fish & seafood†	≥2 t/w v. 2 t/w (ref.)	2.24 (0.84-5.99)	0.29 (0.07-1.22)
Eggs†	≥2 t/w v. 2 t/w (ref.)	0.79 (0.34-1.88)	1.29 (0.51-3.28)
Legumes	≥2 t/w v. 2 t/w (ref.)	1.27 (0.45-3.57)	0.49 (0.13-1.76)
Cereals, grains & products			
Bread†	≥7 t/w v. <7 t/w (ref.)	2.99 (0.90-9.98)	1.02 (0.34-3.01)
Breakfast cereals†	≥5 t/w v. <5 t/w (ref.)	0.56 (0.26-1.19)	1.42 (0.59-3.44)
Biscuits	≥5 t/w v. <5 t/w (ref.)	0.90 (0.43-1.90)	1.09 (0.48-2.45)
Pasta & rice dishes	≥5 t/w v. <5 t/w (ref.)	0.24 (0.08-0.76)*	2.45 (0.88-6.83)
Pizza†	≥2 t/w v. 2 t/w (ref.)	0.62 (0.21-1.83)	1.19 (0.31-4.59)
Fruits			
Fresh fruits†	≥2/day v. 2/day (ref.)	1.74 (0.78-3.88)	1.90 (0.79-4.59)
Fruit juices	≥7 t/w v. <7 t/w (ref.)	0.62 (0.21-1.83)	1.65 (0.70-3.89)
Canned fruits	≥2 t/w v. <2 t/w (ref.)	1.64 (0.43-6.19)	0.76 (0.12-4.71)
Vegetables†	≥2/day v. <2/day (ref.)	1.78 (0.36-8.83)	1.23 (0.40-3.81)
Nuts†	≥2 t/w v. 2 t/w (ref.)	0.50 (0.22-1.10)	1.31 (0.50-3.40)
Potatoes & tubercles†	≥2 t/w v. 2 t/w (ref.)	1.74 (0.79-3.88)	1.36 (0.57-3.26)
Fats			
Olive oil	≥7 t/w v. <7 t/w (ref.)	0.87 (0.40-1.88)	0.97 (0.42-2.25)
Others oils & fats	≥2 t/w v. <2 t/w (ref.)	0.41 (0.18-0.96)*	0.75 (0.32-1.80)
High fat foods	≥5 t/w v. ≤4 t/m (ref.)	0.72 (0.28-1.86)	0.49 (0.15-1.64)
	2-4 t/w v. ≤4 t/m (ref.)	1.50 (0.61-3.74)	0.76 (0.28-2.04)
	≤4 t/m (ref.)		
Drinks			
Soft drinks	≥5 t/w v. ≤4 t/m (ref.)	0.43 (0.18-1.02)	1.46 (0.62-3.46)
	2-4 t/w v. ≤4 t/m (ref.)	0.52 (0.15-1.77)	0.33 (0.04-2.87)
	≤4 t/m (ref.)		
Tea & coffee	≥2 t/w v. 2 t/w (ref.)	2.14 (0.65-7.11)	0.74 (0.24-2.26)
Alcoholic beverages	≥1 t/w v. <1 t/w (ref.)	0.79 (0.19-3.20)	3.32 (0.44-25.29)
Other groupings			
Sweets	≥5 t/w v. ≤4 t/m (ref.)	2.64 (0.71-9.77)	1.01 (0.30-3.42)
	2-4 t/w v. ≤4 t/m (ref.)	1.36 (0.30-6.06)	1.38 (0.37-5.17)
	≤4 t/m (ref.)		
Chocolates	≥5 t/w v. ≤4 t/m (ref.)	0.50 (0.13-1.90)	0.09 (0.01-0.74)*
	2-4 t/w v. ≤4 t/m (ref.)	1.25 (0.41-3.80)	0.56(0.13-2.55)
	≤4 t/m (ref.)		
KIDMED index scores§			
Low quality diet (0-3)		1.00 (ref.)	1.00 (ref.)
Mid-quality diet (4-7)		1.38 (0.50-3.83)	1.31 (0.50-3.41)
Optimal quality diet (8-12)		2.02 (0.69-5.93)	2.30 (0.77-6.88)

Abbreviations: CI, confidence interval; ref., reference; t/w, times/week; t/m, times/month.
[1]Since the prevalence of overfat satisfied with own body shape was only 0.5% (n=3) this group was not considered in this analysis.
† Food consumption cut-offs according to Lazarou et al. [28,29]
‡Multivariate analysis (multiple logistic regression analysis considering the simultaneous effect of all explanatory variables) adjusted by age, parental educational level, parental socio-economic status,

breakfast habit and number of daily meals and snacks, media screen time and physical activity. Significant differences: *$P<0.05$; **$P<0.01$; ***$P<0.001$.
§Univariate analysis (logistic regression analysis considering the effect of one explanatory variable) adjusted by age, parental educational level, parental socio-economic status, breakfast habit and number of daily meals and snacks, media screen time and physical activity.
Only adolescents who did not mis-report their EI were considered for this analysis.

FIGURES

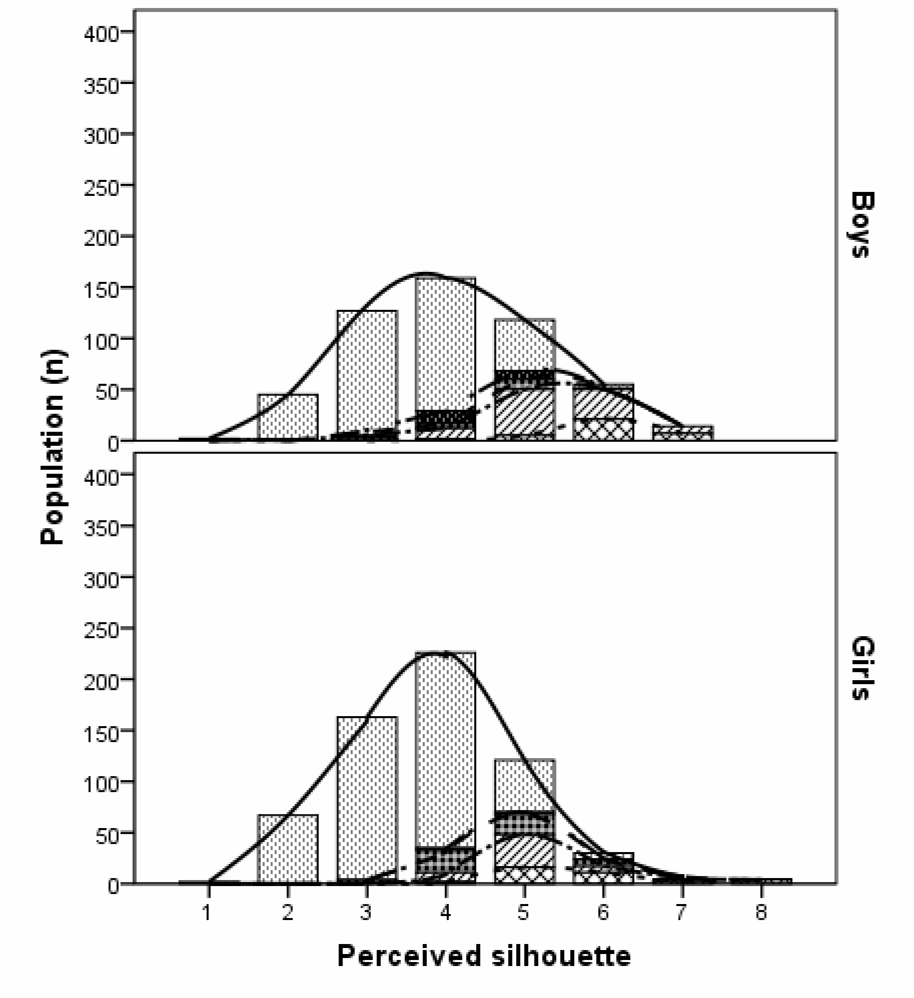

Figure 1. Prevalence of boys and girls by perceived silhouette according to the 5 groups of study: normal-weight normal-fat; normal-weight overfat, overweight normal-fat, overweight overfat, obesity.

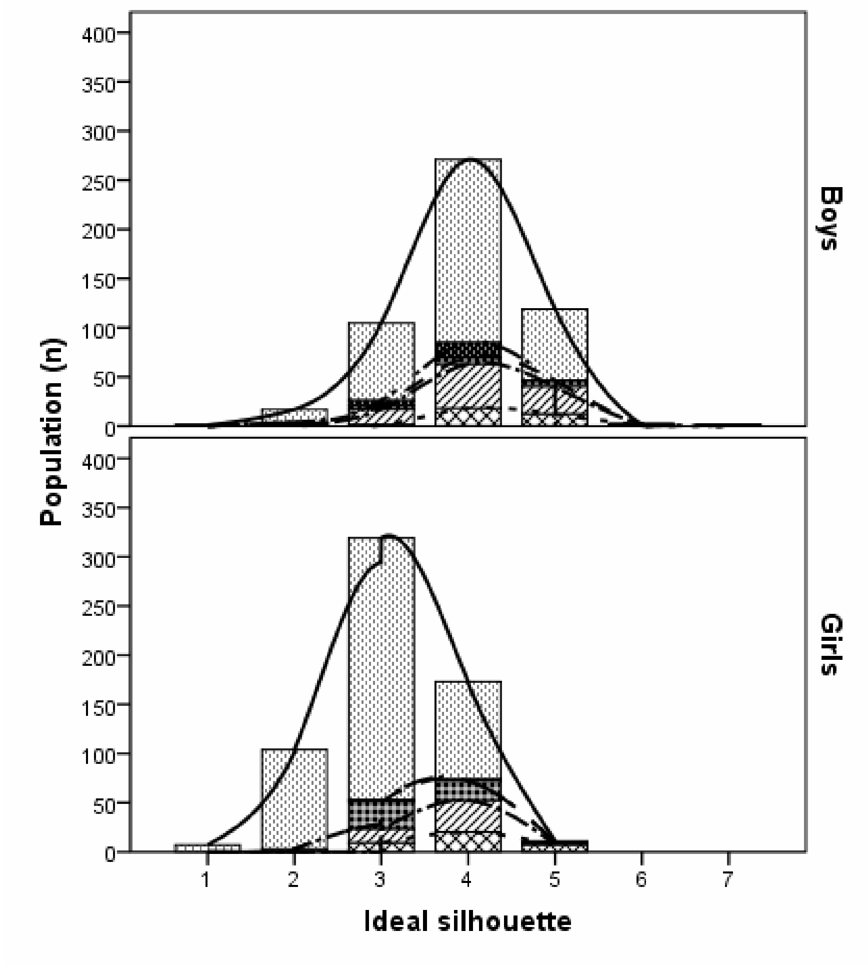

Figure 2. Prevalence of boys and girls by ideal silhouette according to the 5 groups of study: normal-weight normal-fat; normal-weight overfat, overweight normal-fat, overweight overfat, obesity.

Manuscrit VIII

Meal patterns, dietary habits and compliance with Mediterranean Diet Quality Index (KIDMED) among Balearic Islands' adolescents.

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Meal patterns, dietary habits and compliance with Mediterranean Diet Quality Index (KIDMED) among Balearic Islands' adolescents

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Abstract

Background: Dietary behaviors have been associated with the development of various chronic diseases and the younger generations are also further away from the Mediterranean diet (MD), the best healthy eating for its contribution to a favorable health status and a better quality life.

Objective: To determine meal patterns and dietary habits and to evaluate the quality of Balearic Islands adolescents' diet by the compliance with Mediterranean Diet Quality Index (KIDMED), as well as socio-economic and lifestyle determinants. We also examined how the intake of various food groups varies with different levels of adherence to the MD.

Methods: Cross-sectional nutritional survey carried out (2007-2008) in the Balearic Islands, a Mediterranean region. A random sample (n=1,231) of the adolescent population (12-17 years old) was interviewed. Dietary assessment was based on a 145-item semi-quantitative FFQ and two non-consecutive 24h recalls. Compliance with MD was evaluated by KIDMED index. Anthropometric measurements and questions related to socio-economic, lifestyle, physical activity and body image were assessed.

Results: About 24% of boys and 38% of girls reported to skip breakfast ($P<0.001$), and 78.4% of them reported to breakfast in less than 10 minutes. Evaluation of the overall quality diet by KIDMED index showed that 28.9% of adolescents had an optimal quality diet, 56.4% a mid-quality/need-improvement diet and 14.8% a low quality diet. Boys had higher percentages of optimal (32.7%) and lower of low (10.8%) diet quality than the girls (25.7% and 18.0%, respectively). Logistic regression analysis showed that usually breakfast was associated with diet quality in girls. Multiple logistic regression analysis showed that adolescents with an optimal quality diet were more likely to eat yogurt & cheese, legumes, breakfast cereals, fresh fruit, vegetables, nuts, olive oil and tea & coffee and less likely to eat high fat foods.

Conclusions: The present results supports that the food pattern of Balearic Islands' adolescents is in a transitional state characterized by the loss of the traditional MD. An optimal quality diet by KIDMED index was associated with healthy foods. A low quality diet was associated with skip breakfast in girls, which may explain controversial results in sex quality diet between different MD indices. Therefore, high KIDMED scores are positively associated not only with the MD pattern but also healthy dietary practices such as breakfast habit.

Keywords: Adolescents, dietary habits, Mediterranean diet, KIDMED index, Balearic Islands

Introduction

Adolescence is a transitional stage and many changes take place at physiologic and behavioural levels, representing an important life stage for the development of healthy nutrition [1]. Many different factors influenced food habits in a complex interactive way [2]. Socio-economic and lifestyle factors (parental occupational status, maternal level of education, cultural and/or religious habits, and the role of family and patterns of beauty) are factors that have a strong influence on eating habits in adolescents [3].

It is common for adolescents to skip meals and snack frequently and young people are now surrounded by products which are high-sugar, high-salt, high-fat, attractive, palatable and durable, but in many cases are nutritionally poor [4]. Because there is evidence that nutritional behaviours track from adolescence into adulthood, the promotion of healthy nutrition during adolescence has the potential to confer significant long-term health benefits [1].

The Mediterranean diet (MD) has been widely reported to be a model of healthy eating for its contribution to a favorable health status and a better quality of life [5]. Adherence to a MD can significantly decrease the risk of overall mortality, and all the major scientific associations strongly encourage people to consume a Mediterranean-like dietary pattern to reduce their risk of disease [5].

In view of the above, the aim of the present study was to determine meal patterns and dietary habits and to evaluate the quality of Balearic Islands adolescents' diet by the compliance with Mediterranean Diet Quality Index (KIDMED), as well as socio-economic and lifestyle determinants. We also examined how the intake of various food groups varies with different levels of adherence to the MD.

Methods

Study design

The study is a population-based cross-sectional nutritional survey carried out in the Balearic Islands (2007-2008).

Selection of participants, recruitment and approval

A multicenter study was performed on Balearic Islands' adolescents aged 12–17 years. The population was selected by means of a multiple-step, simple random sampling, taking into account first the location (Palma de Mallorca, Calvià, Inca, Manacor, Maó, Eivissa, Llucmajor, Santa Margalida, S'Arenal, Sant Jordi de Ses Salines) and then by random assignment of the schools within each city. Sample size was stratified by age and sex. The socioeconomic variable was considered to be associated to geographical location and type of school. As the selection of schools was done by random selection and fulfilling quota, this variable was also considered to be randomly assigned.

To calculate the number of adolescents to be included in the study in order to guarantee a representative sample of the whole Balearic Islands, we selected the variable with the greatest variance for this age group from the data published in the literature at the time the study was planned; that was BMI [6]. The sampling was determined for the distribution of this variable; the CI was established at 95% with an error ± 0.25. The established number of subjects was 1,500. The total number of subjects was uniformly distributed in the cities and proportionally distributed by sex and age group.

The sample was oversized to prevent loss of information and as necessary to do the fieldwork in complete classrooms. In each school, all the adolescents of one classroom were proposed to participate in the survey. A letter about the nature and purpose of the study informed parents or legal tutors. After receiving their written consent, the adolescents were considered for inclusion in the study. After finishing the field study, the adolescents who did not fulfill the inclusion criteria were excluded. Finally, the sample was adjusted by a weight factor in order to balance the sample in accordance to the distribution of the Balearic Islands' population and to guarantee the representativeness of each of the groups, already defined by the previously mentioned factors (age and sex). The final number of subjects included in the study was 1,231 adolescents (82% participation). The reasons to not participate were (a) the subject declined to be interviewed, and (b) the parents did not authorize the interview.

This 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 (Palma de Mallorca, Spain).

Dietary assessment

Dietary questionnaires included two non-consecutive 24 hour diet recall periods, one in the warm season (May-September) and one in the cold season (November-March) to account for the influence of seasonal variations, and a semi-quantitative food-frequency questionnaire (FFQ) that has previously been validated [7] and applied in other studies and surveys over the Spanish population [8-12]. The FFQ, which asked the participant 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) 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. The period of consumption of seasonal items was also considered. Edible fractions of foods were recorded in the database. The FFQ foods items were collapsed to twenty-eight food groups (Table 2) that may have practical importance in daily diet and closely approximated food groups previously reported [13,14]. To account for day-to-day intake variability, the questionnaires were administered homogeneously from Monday to Sunday. Well-trained dietitians administered the recalls and verified and quantified the food records.

To estimate volumes and portion sizes, the household measures found in the subjects' own homes were used. Conversion of food into nutrients was made using a self-made computerized program (ALIMENTA®; NUCOX, Palma, Spain) based on Spanish [15,16] and European [17] food composition tables, and complemented with food composition data available for Majorcan food items [18]. Identification of mis-reporters was conducted on the basis of the ratio of energy intake (EI) to BMR. EI:BMR <0.92 (boys) and <0.85 (girls) was considered to represent underreporting [19], while EI:BMR≥2.4 was considered to represent over-reporting [20,21]. Under-reporters (20%) and over-reporters (2%) were excluded from the analysis.

Assessment of Mediterranean diet patterns

The quality of diet by the compliance with MD was evaluated using the KIDMED index (Mediterranean diet quality index for children and adolescents), described elsewhere [22]. Based on the given answers, the test classified individuals according to the quality of the MD categorized as: optimal quality, mid-quality/needs-improvements and low quality.

Sociodemographic and lifestyle variables

A questionnaire incorporating the following questions was used: age group; parental educational level (according to years and type of education: low, <6 years; medium, 6-12 years; high, >12 years); parental socio-economic level (based on the occupation of parents and classified as low, medium and high, according to the Spanish Society of Epidemiology [23].

The number of daily meals and snacks was calculated from the total eating occasions that participants declared among the following: breakfast; mid-morning snack; lunch; mid-afternoon snack; dinner; before going to sleep; others. Three groups of eating frequency were considered: ≤3, 4 and ≥5 times/d. Information about breakfast habit (yes; occasionally; no), time of the main meals (breakfast, lunch and dinner) was also collected (<10 min; 10-20 min; >20 min).

Distraction during mealtime was studied using different possibilities: (1) watching TV; (2) listen to the radio; (3) get up from the table; (4) conversation during mealtime. These variables were joined and expressed as (1) attention to mass media (TV + radio); (2) others.

Anthropometry measurements

Height was determined using a mobile anthropometer (Kawe 44444, Asperg, Germany) to the nearest millimeter, with the subject's head in the Frankfurt plane. Body weight was determined to the nearest 100g using a digital scale (Tefal, sc9210, Rumilly, France). The subjects were weighed in bare feet and light underwear. The subjects were asked to stand erect in a relaxed position with both feet together on a flat surface. Triceps and subscapular skinfold thickness (ST) were measured at the right side of the using a Holtain skinfold calliper (Tanner/Whitehouse, Crosswell, Crymych, UK), and the mean of three measurements was used. Height and weight measures were used to calculate body mass index (BMI, kg/m^2). Body fat percentage (%BF) was measured from triceps and subscapular ST according to Slaughter *et al*. [24]. This equation has been proposed as the most accurate for estimation of %BF from ST in this particular population of adolescents [25]. %BF and height were used to calculate fat mass index (FMI; kg/m^2).

Defining overweight and obesity

In children and adolescents, BMI for age has been established as the main measurement to define overweight and obesity [26]. However, there are some limitations associated with its use as an indicator of fatness. For example, individuals with increased muscle mass may also have increased BMI [27]. On the other hand, individuals with decreased lean body mass and increased adiposity may also be misclassified by assessment with BMI [27]. Alvero-Cruz *et al*. [28] showed that the FMI had higher accuracy for overweight screening than BMI. The FMI is a useful measure to evaluate body composition parameters by effectively eliminating differences in body fat associated with height [29]. Nevertheless, it is difficult to exclude BMI from the normal-weight and overweight definition. For this reason, a combination of BMI and FMI was used to define overweight and obesity in the present study.

First, subjects were classified using the age- and sex-specific cut-offs developed and proposed for international comparisons by Cole *et al*. [30], recommended for use also by the International Obesity Task Force. Then, subjects were classified as normal-fat and overfat according to their FMI using the sex-specific cut-offs proposed by Alvero-Cruz *et al*. [28] for adolescents: 4.58 kg/m^2 in boys and 7.76 kg/m^2 in girls. Thus, adolescents were classified into three groups as follows: (i) normal-fat (BMI for age and sex <25 kg/m^2; FMI<4.58 kg/m^2 in boys, FMI<7.76 kg/m^2 in girls); (ii) overweight (BMI for age and sex ≥25-<30kg/m^2; FMI≥4.58 kg/m^2 in boys, FMI≥7.76 kg/m^2 in girls); (iii) obesity (BMI for age and sex ≥30-BMI kg/m^2; FMI≥4.58 kg/m^2 in boys, FMI≥7.76 kg/m^2 in girls). The variable was labeled as 'body composition' [31].

Assessment of physical activity

Physical activity was evaluated according to the guidelines for data processing and analysis of the international physical activity questionnaire (IPAQ) [32] in the short form and its specific modification for adolescents (IPAQ-A) [33]. The specific types of activity assessed were walking, moderate-intensity activities (i.e. physical activity at school), and vigorous-intensity activities (i.e. sport practice). In accordance with the AVENA (Food and Assessment of Nutritional Status of Adolescents) study [34], the questionnaire also included information on television (TV) viewing and computer use and video games in h/d to the nearest 10 min. Physical inactivity was established with a cut-off level of 300 min/week of moderate/vigorous physical activity, in accordance with recent reports of physical activity for adolescents [35,36].

Body image

Perceived body image was measured using the Stunkard scale [37], which consists of silhouette drawings ranging from 1 to 9 with monotonic increments in overweight percentage where 1 is the leanest and 9 is the heaviest. Separate figures for boys and girls were used. Participants were asked to identify of the 9 body figures: (a) ‘Which silhouette looks most like yourself?’ and (b) ‘Which silhouette would you like to look like?’ The difference between perceived body image and desired body image was used to determine the level of dissatisfaction with current body image. Values other than zero represent dissatisfaction with perceived body image. A positive value was indicative of the participant’s desire to be thinner than his/her perceived current size, while a negative value reflected the participant’s desire to be thicker than his/her current perceived size [38,39].

Statistics

Analyses were performed with Statistical Package for the Social Sciences version 19.0 (SPSS, Inc., Chicago, IL, USA). Significant differences in prevalence were calculated by means of χ^2. Logistic regression models with the calculations of corresponding adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were used to examine possible differences between those adolescents who were in the lowest and highest KIDMED score category. Univariate analysis was first carried out for all the socioeconomic and lifestyle variables that could be associated with KIDMED index. Any factor that was significantly associated was considered as a candidate for the multivariate model. Multiple logistic regression analyses were used to simultaneously examine the effect of different socioeconomic and lifestyle variables on the MD quality. We further applied multiple logistic regression analysis evaluating the association between the levels of adherence to the MD (as assessed by the KIDMED score) with the frequencies of consumption of several food groups adjusted for potential confounders (sex, age, parental educational level, parental socio-economic status, body composition, number of daily meals & snacks, media screen time, attention to mass media (TV + radio), physical activity, breakfast habit and desire to change weight). Level of significance for acceptance was P<0.05.

Results

Meal patterns and dietary habits of the participants

Data on basic food-related behaviors, such as breakfast habit, number of daily meals, time for main meals (breakfast, lunch and dinner) and distraction during mealtime by attention to mass media and methods of cooking are presented in Table 1. About 24% of boys and 38% of girls reported to skip breakfast (*P*<0.001), and 78.4% of them reported to breakfast in less than 10 minutes. About 28% of boys and 44% of girls reported having 3 or less daily meals and snacks, while about 37% of boys and 25% of girls reported having at least 5 daily meals and snacks (*P*<0.001). Overall, 8.9% and 13.4% of adolescents reported to lunch and dinner in less than 10 minutes, respectively; while 45.5% and 37.3% reported to lunch and dinner in more than 20 minutes. Many adolescents (73.6%) are distracting especially watching the TV and listen to the radio compared with those that declared to get up from the table [40] and to speak during mealtime. With respect to methods of cooking, 78-85% of adolescents reported to eat fried, grilled and cooked food at least 3 times a week.

Table 2 presents results from analyses carried out to examine differences between boys and girls with regards to the frequency consumption of several food groups and individual food items. Significant differences were observed for 15 food groups or individual items; boys reported more frequent consumption of milk, dairy desserts, red meat, sausages, eggs, breakfast cereals, pizza, canned fruit, nuts, potatoes & tubers, high fat foods, soft drinks, alcoholic beverages and sweets, whereas vegetables were consumed more frequently by girls.

Compliance with Mediterranean Diet Quality Index (KIDMED)

Table 3 presents results examining the KIDMED index test. Overall, evaluation of the compliance with Mediterranean diet quality showed that 28.9% of the sample had an optimal quality diet (≥8 points), 56.4% had a mid-quality/need-improvement diet (4-7 points) and 14.8% had a low quality diet (≤3 points). Evaluation of the overall quality diet by sex showed that boys had higher percentages of optimal (32.7%) and lower of poor (10.8%) diet quality than the girls (25.7% and 18.0%, respectively). The mean score for the Balearic Islands' adolescent population was 6 (SD 2.5), being higher among boys (6.4, SD 2.4) than girls (5.8, SD 2.4). These gender differences were statistically significant. About 56% of both genders had a mid-quality diet (4-7). A higher proportion of boys reported to consume a piece of fruit, 2/3 times weekly of pasta and rice, cereal or cereal product for breakfast, 2/3 times weekly of nuts, dairy product for breakfast and two yogurts and/or 40 g of cheese daily, while the percentage consuming vegetables daily and do not have breakfast was higher among girls.

Socio-economic and lifestyle determinants

As shown in Table 4, significant differences in index scores were observed as a function of the age group and number of daily meals & snacks in boys; and parental educational level, media screen time, distraction during mealtime, physical activity level and breakfast habit in girls. Socio-economic and lifestyle determinants for a low vs. optimal diet quality stratified by sex was also assessed (Table 1). In boys, the multivariate analysis showed that a poor quality diet was associated with ≤3 eating occasions per day while in girls was associated with distraction during mealtime and physical inactivity and was inversely associated to 4 eating occasions daily and usually breakfast habit. The univariate analysis also showed that in girls a poor diet quality was also associated with low parental educational level, low parental socio-economic status and ≥4 h/d use media screen. However, all these variables lost its statistical significance after being adjusted for all explanatory variables. The other lifestyle variables considered in the present study (age group, body composition and desire to change weight) were not significantly associated with a poor diet quality in any gender.

Associations between intake of various food groups and KIDMED scores

Associations between the frequencies of consumption of various food groups and individual food items and the level of compliance with Mediterranean diet quality (low v. mid v. optimal KIDMED score) were also evaluated (Table 5). Compared with low quality diets' adolescents, those with an optimal diet consumed more milk, yogurt & cheese, fish & seafood, eggs, legumes, bread, breakfast cereals, biscuits, fresh fruits, fruit juices, canned fruits, vegetables, nuts and olive oil; and consumed less high fat foods and soft drinks.

After applying multiple logistic regression analysis in order to control for various potential confounders (i.e. age, parental educational level, parental socio-economic status, body composition, number of daily meals & snacks, media screen time, attention to mass media (TV + radio), physical activity, breakfast habit and desire to change weight) and estimate the size of any observed differences, several of the differences that bivariate analysis showed diminished. Specifically, compared with adolescents who had a low quality diet, those with a mid-quality diet were more likely to eat frequently milk, yogurt & cheese, biscuits, fruit fresh and were less likely to eat frequently high fat foods. Effect size of this observed differences increased in optimal quality diets that also were related to a higher consumption of legumes, breakfast cereals, nuts and lower frequency consumption of soft drinks. Adolescents with an optimal diet were more likely to eat frequently yogurt & cheese, legumes, breakfast cereals, fresh fruits, vegetables, nuts, olive oil and tea & coffee and were also less likely to consume high fat foods than those with a mid-quality diet. It should be noted that after the application of multiple logistic analysis, the associations between

KIDMED score and the frequency of consumption of fish & seafood, eggs, bread and canned fruits disappeared in both mid- and optimal quality diet.

It should also be noted that no differences emerged between adolescents with an optimal and low quality diet, with regard to the consumption of dairy desserts, red meat, poultry & rabbit, pasta & rice dishes, pizza, potatoes & tubercles, other oils & fats, alcoholic beverages, sweets and chocolates and most of them should not be consumed daily or even weekly according to the MD pattern.

Discussion

The present study evaluated meal patterns, dietary habits and overall quality of adolescents' diet in relation to the MD model using the KIDMED index among the Balearic Islands' adolescents. Our results indicated that about 32% of adolescents do not have breakfast daily, 78.4% breakfast in less than 10 minutes and 36.5% declared ≤3 eating occasions per day. Meal pattern and omission of meals, especially skipped breakfast, have been suggested as markers of an inappropriate dietary intake among adolescents [41], and in a previous study we found that certain dietary practices, such as eating breakfast, number of meals per day and distraction during mealtime were associated with adolescent obesity [40]. Gender also appeared to influence food-related behaviours, such as having breakfast and number of daily meals & snacks. Similarly to previous studies [14], we found that girls are more likely to skip the first main meal of the day, in all likelihood as a means to lose weight [14,40].

The traditional MD pattern is characterized by a high intake of vegetables, legumes, fruits and nuts, and cereals (which in the past were largely unrefined), a high intake of olive oil but a low intake of saturated lipids, a moderately high intake of fish (depending on the proximity of the sea), a low-to-moderate intake of dairy products (and then mostly in the form of cheese or yogurt), a low intake of meat and poultry and a regular moderate intake of ethanol, primarily in the form of wine and generally during meals [42]. The traditional MD pattern has been associated with a reduced risk of several non-transmittable chronic diseases and with prolonged survival: hence, the MD pattern has been promoted as a model for healthy eating [43-45]. However, epidemiological evidence suggests that dietary patterns in the Mediterranean countries are changing rapidly, with an increased consumption of animal products and saturated fat and a decline in intake of basic foodstuffs based on vegetables [46]. In the present study, several negative trends with regards to adolescents' diet were also observed. In fact, a large percentage of adolescents reported frequency of consumption of fish & seafood, legumes, pasta & rice dishes, fresh fruits, vegetables and nuts that are below recommended levels, while a large percentage of adolescents declared a high frequency consumption of high fat foods, soft drinks and sweets.

To assess the overall quality of adolescents' diet in relation to the MD model we used the KIDMED index [22]. The present study showed that 14.8% of adolescents had a low quality diet and 28.9% had an optimal quality diet, supporting evidence for a gradually nutrition transition from a traditional healthy diets toward a more Western-type diet as have been previously described [31]. The previous study conducted in Spain by Serra-Majem *et al*. [22] in a sample of 3850 Spanish children and young people aged 2-24 years, found that using their proposed index 46.4% (2-14 years: 48.5%; 15-24 years old: 44.6%) of young people had an optimal MD quality diet and 4.2% (2-14 years old: 2.9%; 15-24 years old: 5.3%) had a poor quality diet. A previous study comprised 3190 children and adolescents (8-16 years) from Granada (in Southern Spain) found that 48.6% of the 8-10 years old population and 46.9% of the 10-16 years old population had an optimal quality diet; while 1.6% and 2.0%, respectively, had a poor quality diet [47]. A study conducted in Pamplona that evaluated quality diet among 1956 adolescents by KIDMED index found similar results: 42.9% of the sample had an optimal quality diet and 6.7% a poor quality diet [48]. However, a previous study conducted by Kontogianni *et al*. [49] in a representative sample of 1305 Greek children and adolescents (3-18 years) that assessed adherence to MD by applying the KIDMED index also found that only a small percentage of adolescents (8.3%) obtained an optimal quality diet; and 14.9% of adolescents had a poor quality diet. A study conducted in 1140 children (9-13 years old) from Cyprus also found that only 6.7% of the sample was classified as high adherers to the MD, whereas 37% had a poor diet quality [13,14].

Controversial results in sex quality diet using the KIDMED index has been found in the literature [13,47]. In the present study, more boys (32.7%) than girls (25.7%) were classified in the 'optimal' KIDMED index category, despite that girls showed higher adherence and lower risk of having low adherence to the MD than boys [50]. This controversial result may be explained in part by the lack of statistical significant differences in fresh fruits, pasta & rice dishes and yogurts & cheese consumption by FFQ between boys and girls suggesting that boys over-reported the consumption of these food groups in the KIDMED test.

On the other hand, it is important to note that four items of the KIDMED index are related to breakfast, which was associated with quality diet in girls. It is well established that girls skipped breakfast more often than boys, and its consumption has been identified as an important factor in the nutritional well being of children being rarely compensated for in other meals of the day [51]. In this face, girls who did not breakfast showed lower consumption of milk and breakfast cereals and also a higher consumption of soft drinks, alcohol and high fat foods. However, previous works also reported that girls paid more attention to foods than boys as a way to influence health and to meet nutritional recommendations [52]. In this face, boys showed higher consumption of several food groups (i.e. dairy desserts, red meat, sausages, eggs, breakfast cereals, pizza, canned fruits, nuts, high fat foods, soft drinks and sweets) most of them not necessary consumed during breakfast and identified previously in a Western dietary pattern that was more likely followed by boys than girls [31].

Nevertheless, as have been reported previously [13] an optimal quality diet was positively associated with healthy foods and this finding may provide some support for the validity of the index, which not only assessed diet quality but also healthy dietary practices such as breakfast habit. MD indices have a number of limitations and problems in their use although that grouping foods to obtain scores is a very useful method to evaluate overall diet [49,53]. It is also generally acknowledged that diet should be assessed holistically taking into account foods and food groups' consumed as well as, dietary practices, such as meal patterns [54].

It should be also noted that number of daily meals and snacks were also associated with diet quality. Thus, ≥4 eating occasions per day in boys and 4 eating occasions per day in girls were associated with higher probability of an optimal quality diet; and in a previous study eating frequency was identified as a risk factor for obesity in both boys and girls [40]. Therefore, a promotion of at least 5 daily meals and snacks should be considered in nutrition education programmes for adolescents aimed at reducing risk of disease. However, education programmes could also focus on strategies to promote healthy food choices following the MD.

In girls, it is important to note that not only breakfast habit and eating frequency was associated with quality diet, but also distraction during mealtime, physical inactivity, as well as ≥4 h/d using media screen, low parental educational level and low parental socio-economic status (despite that these variables lost its statistical significance in the multivariate analyses).

A positive association between BMI and distraction during mealtime has been detected previously [40]. TV viewing during mealtime is inversely associated with consumption of products not advertised, such as fruits and vegetables [55]. Moreover, an association between >2 h/d watching TV and major consumption of high-fat snacks and high-sugar drinks has been demonstrated [56,57]. TV clearly transmits a conflicting message related to exposure to the advertising of unhealthy foods [51]. We have also reported that girls who spent ≥2 h/d on media screen were more likely to follow a 'Western' dietary pattern, as well as those boys who spent ≥4 h/d [31].

It is widely accepted that a greater adherence to the MD is associated with high antioxidant capacity [58]. However, Kavouras *et al*. [59] observed that was both the MD and frequent exercise combination that enhanced antioxidant defenses; whereas the combination of sedentary lifestyle and a high fat diet, rich in saturated fats, induced oxidative stress. It has been suggested that children who follow a healthy diet are those who might also maintain high levels of physical activity [60]. A previous study also reported a positively association between quality diet and leisure-time physical activity [61], and we also showed that sedentary and low-active adolescents had lower adherence and higher risk of low adherence to the MD than active and very active adolescents [50].

In previous studies we also found that maternal educational level was associated to the quality of diet [9] and lower adherence to the MD [50]. Moreover, a study conducted among adults in our community also found that the lower socio-economic and educational levels were at a higher risk of low intake of foods rich in antioxidant nutrients [10].

It is also well known that the MD is an interesting alternative in health promotion because this pattern, and not only its individual nutrients, has been postulated as being protective against several diseases [42,45,50,54,62]. In the present study, obesity status was not associated to quality diet. However, controversial results in adherence to the MD and obesity in children and adolescents has been found regarding the literature. While some investigations observed an inverse association between MD pattern and BMI [49,60,63-65], others found no correlation [66]. A study comprised 2513 Spanish children and adolescents aged 10-24 years old which assessed adiposity by waist circumference and waist-to-height ratio found an inversely association of both indicators with the adherence to the MD obtained also by the KIDMED index [61].

Body image has also been found to be a powerful determinant of adolescent nutritional habits and food choices [67]; and despite that in the present study no association between desire to change weight and diet quality was found, in a previous study we reported that a desire for a thinner body shape was associated with low risk for a 'Western' dietary pattern [31].

Limitations of the study

Dietary and physical activity data were based on self-reports [60]. The literature reports that food under-reporting is usually associated with gender and weight status [63,68]. Self-report of physical activity also can lead to over-report the physical activity due to social desirability bias, and therefore the number of inactive individuals may be greater than that reported [69,70], especially among children and adolescents, and also among obese [69]. However, in many cases, self-reporting is the only feasible method of assessing physical activity [71] and dietary intake in epidemiological studies. Although epidemiologists made every effort to get as accurate data as possible, there is a possibility that misreporting occurred [14].

The FFQ did not differentiate between wholegrain and white bread. However, Ribas-Barba *et al*. [72] found a slight percentage of daily wholegrain consumers (14.2%) among the Catalonia population aged 10-75 years, with a high percentage of never consumers of wholegrain bread (71.3%). Therefore, we would expect that bread was consumed mostly as white bread.
Body fat was calculated using Slaughter *et al.'s* equations [24] which have been suggested previously by Rodríguez *et al*. [25]. However, the present study did not take into account pubertal development despite that chronological age may vary dramatically during this phase. Therefore, as in a previous study [73] in which adolescents have been classified according to their pubertal stage, boys were divided into two groups: pubertal (12 to 14 years old) and post-pubertal (15 to 17 years old).

Conclusion

In conclusion, a high percentage of Balearic Islands' adolescents follow a low quality diet as assessed by the principles of MD, supporting that adolescents' food pattern is in a transitional state characterized by the loss of the traditional MD. An optimal quality diet by KIDMED index was associated with healthy foods. A low quality diet was associated with skip breakfast in girls, which may explain controversial results in sex quality diet between different MD indices. Therefore, high KIDMED scores are positively associated not only with the MD pattern but also healthy dietary practices such as breakfast habit.

Adolescents constitute priority targets for action and should be more aware about dietary habits and the MD pattern and its health benefits. Programmes to promote healthy meal patterns and the traditional MD pattern among not only adolescents but also their families, combined with an active lifestyle, would like result in a more favorable future health profile.

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Authors' contributions

MMB, JP and JAT conceived, designed, devised and supervised the study, MMB, JP and JAT collected and supervised the samples. MMB and JAT analyzed the data and wrote the manuscript. AP and JAT obtained funding. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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Table 1. Meal patterns among Balearic Islands' adolescents, Spain, 2007-2008[1]

	Total (*n*=1231)	Boys (*n*=574)	Girls (*n*=657)	*P*
Breakfast habit				
Yes	68.3	75.8	61.8	0.000
Occasionally	18.5	15.2	21.4	
No	13.2	9.0	16.8	
Number of daily meals & snacks				
≤3	36.5	27.7	44.1	0.000
4	32.6	34.9	30.7	
≥5	30.9	37.4	25.3	
Breakfast time				
<10 min	78.4	79.0	77.9	0.845
10-20 min	19.0	18.6	19.3	
>20 min	2.6	2.4	2.8	
Lunch time				
<10 min	8.9	10.8	7.2	0.055
10-20 min	45.7	46.0	45.3	
>20 min	45.5	43.1	47.5	
Dinner time				
<10 min	13.4	13.8	13.1	0.781
10-20 min	49.3	50.0	48.7	
>20 min	37.3	36.2	38.2	
Attention to mass media (TV + radio)				
Yes	73.6	71.4	75.5	0.107
No	26.4	28.6	24.5	
Eat fried food				
≤2 times/week	78.6	75.5	81.2	0.022
≥3 times/week	21.4	24.5	18.8	
Eat grilled food				
≤2 times/week	81.5	82.5	80.7	0.440
≥3 times/week	18.5	17.5	19.3	
Eat cooked food				
≤2 times/week	85.0	84.3	85.5	0.568
≥3 times/week	15.0	15.7	14.5	

[1]Values are %. Significant differences between groups were evaluated by χ^2.

Table 2. Food consumption by frequency category among adolescents' boys and girls from the Balearic Islands, Spain, 2007-2008[1]

Food groups	Frequency categories	Total (*n*=1231)	Boys (*n*=574)	Girls (*n*=657)	*P*
Dairy products					
Milk†	≥7 times/week	71.8	79.4	65.7	0.000
Yogurt & cheese	≥7 times/week	64.6	67.7	62.1	0.082
Dairy desserts	≥2 times/week	69.5	76.7	63.9	0.000
Meat					
Red meat†	≥2 times/week	48.8	54.7	44.2	0.002
Poultry & rabbit†	≥2 times/week	15.2	15.0	15.3	0.901
Sausages†	≥5 times/week	49.8	52.9	47.4	0.102
	2-4 times/week	25.8	27.0	24.9	0.485
	≤4 times/month	24.4	20.2	27.7	0.009
Fish & seafood†	≥2 times/week	16.8	19.4	14.7	0.064
Eggs†	≥2 times/week	28.6	35.5	23.1	0.000
Legumes	≥2 times/week	18.1	19.8	16.8	0.250
Cereals, grains & products					
Bread†	≥7 times/week	83.7	85.2	82.6	0.286
Breakfast cereals†	≥5 times/week	39.2	49.6	30.9	0.000
Biscuits	≥5 times/week	22.1	21.8	22.2	0.904
Pasta & rice dishes	≥5 times/week	18.8	21.1	17.0	0.124
Pizza†	≥2 times/week	13.9	16.5	11.9	0.045
Fruits					
Fresh fruits†	≥2/day	30.9	30.6	31.1	0.868
Fruit juices	≥7 times/week	52.2	53.4	51.3	0.531
Canned fruits	≥2 times/week	6.9	9.3	5.0	0.011
Vegetables†	≥2/day	10.4	7.3	12.9	0.006
Nuts†	≥2 times/week	30.6	38.1	24.8	0.000
Potatoes & tubercles†	≥2 times/week	38.3	43.4	34.3	0.005
Fats					
Olive oil	≥7 times/week	51.7	49.1	53.8	0.164
Others oils & fats	≥2 times/week	37.4	38.8	36.3	0.435
High fat foods	≥5 times/week	41.2	46.3	37.1	0.005
	2-4 times/week	28.1	27.0	28.9	0.510
	≤4 times/month	30.7	26.7	33.9	0.020
Drinks					
Soft drinks	≥5 times/week	48.5	56.2	42.4	0.000
	2-4 times/week	11.0	11.3	10.8	0.800
	≤4 times/month	40.5	32.5	46.8	0.000
Tea & coffee	≥2 times/week	15.2	12.8	17.0	0.083
Alcoholic beverages	≥1 times/week	6.0	9.0	3.6	0.001
Other groupings					
Sweets	≥5 times/week	76.3	73.8	78.4	0.111
	2-4 times/week	13.3	13.4	13.2	0.957
	≤4 times/month	10.4	12.8	8.4	0.031
Chocolates	≥5 times/week	19.7	21.2	18.6	0.339
	2-4 times/week	11.5	11.3	11.6	0.902
	≤4 times/month	68.8	67.5	69.8	0.462

[1]Values are %. Significant differences between groups were evaluated by χ^2.
† Food consumption cut-offs according to Lazarou *et al*. [13,14]
Only adolescents who did not mis-report their energy intake were considered for this analysis.

Table 3. Compliance with Mediterranean Diet Quality Index (KIDMED) by sex among Balearic Islands' adolescents, Spain, 2007-2008[1]

	Total (*n*=1231)	Boys (*n*=574)	Girls (*n*=657)	*P*
KIDMED test				
Fruit or fruit juice daily	83.5	86.9	80.0	0.013
Second serving of fruit daily	49.2	48.8	49.6	0.938
Fresh or cooked vegetables daily	61.0	55.7	65.3	0.003
Fresh or cooked vegetables >1/d	29.9	30.7	29.4	0.671
Regular fish consumption (at least 2-3/week)	51.7	52.7	51.0	0.613
Fast-food (hamburger) restaurant >1/week	17.7	18.9	16.7	0.371
Legumes >1/week	54.0	54.9	53.4	0.654
Pasta or rice almost daily (≥5/week)	50.7	56.0	46.3	0.004
Cereal or cereal product for breakfast	65.7	71.4	61.1	0.001
Regular nut consumption (at least 2-3/week)	42.9	50.2	36.9	0.000
Use of oil olive at home	88.8	87.6	89.8	0.283
No breakfast	23.0	16.8	28.0	0.000
Dairy product for breakfast	72.8	80.1	66.9	0.000
Commercially baked foods or pastries for breakfast	32.3	35.4	29.8	0.068
Two yogurts and/or 40 g cheese daily	57.2	60.9	54.2	0.040
Sweets and candy several times a day	31.8	28.9	34.1	0.090
KIDMED index scores				
Low quality diet (0-3)	14.8	10.8	18.0	0.003
Mid-quality/needs-improvement diet (4-7)	56.4	56.5	56.3	0.946
Optimal quality diet (8-12)	28.9	32.7	25.7	0.022

[1]Values are %. Significant differences between groups were evaluated by χ^2.
Only adolescents who did not mis-report their energy intake were considered for this analysis.

Table 4. Socio-economic and lifestyle determinants of compliance with Mediterranean Diet Quality Index (KIDMED) among adolescents by sex, Balearic Islands, Spain, 2007-2008

	Boys						Girls					
					Low (0-3) *v.* optimal (8-12) quality diet						Low (0-3) *v.* optimal (8-12) quality diet	
Variable	**Low (%)**	**Mid (%)**	**Optimal (%)**	***P*†**	**Crude OR (95% CI)‡**	**Adjusted OR (95% CI)§**	**Low (%)**	**Mid (%)**	**Optimal (%)**	***P*†**	**Crude OR (95% CI)‡**	**Adjusted OR (95% CI)§**
Age group												
12-13 years old	11.4	26.1	20.3	0.042	0.37 (0.12-1.19)	0.32 (0.06-1.61)	20.0	20.9	25.6	0.307	0.49 (0.22-1.07)	0.81 (0.23-2.81)
14-15 years old	59.1	46.5	60.2		0.65 (0.29-1.45)	0.39 (0.13-1.21)	50.0	52.1	55.8		0.56 (0.29-1.08)	0.40 (0.15-1.10)
16-17 years old	29.5	27.4	19.5		1.00 (ref.)	1.00 (ref.)	30.0	27.0	18.6		1.00 (ref.)	1.00 (ref.)
Parental educational level												
Low	30.0	36.1	25.6	0.370	1.20 (0.50-2.85)	1.72 (0.47-6.24)	44.8	38.1	24.6	0.005	3.77 (1.81-7.88)***	3.11 (0.76-12.71)
Medium	30.0	27.8	33.6		0.91 (0.39-2.14)	0.87 (0.25-2.96)	36.8	31.1	37.3		2.04 (0.99-4.21)	3.17 (0.86-11.64)
High	40.0	36.1	40.8		1.00 (ref.)	1.00 (ref.)	18.4	30.7	38.1		1.00 (ref.)	1.00 (ref.)
Parental socio-economic level												
Low	23.1	18.1	20.8	0.812	0.91 (0.33-2.55)	0.75 (0.16-3.64)	34.2	24.7	20.0	0.099	2.50 (1.00-6.26)*	1.68 (0.30-9.40)
Medium	48.7	58.8	56.0		0.72 (0.30-1.69)	0.34 (0.09-1.28)	52.6	52.5	60.8		1.26 (0.55-2.90)	0.80 (0.20-3.26)
High	28.2	23.1	23.2		1.00 (ref.)	1.00 (ref.)	13.2	22.8	19.2		1.00 (ref.)	1.00 (ref.)
Body composition												
Normal-fat	70.5	80.4	76.4	0.540	0.53 (0.12-2.36)	0.12 (0.01-1.38)	89.9	90.6	89.3	0.552	0.73 (0.14-3.73)	2.62 (0.36-19.10)
Overweight	22.7	16.9	19.7		0.67 (0.13-3.33)	0.25 (0.03-2.14)	6.7	4.7	8.2		0.60 (0.09-3.99)	0.59 (0.06-5.66)
Obesity	6.8	2.7	3.9		1.00 (ref.)	1.00 (ref.)	3.4	4.7	2.5		1.00 (ref.)	1.00 (ref.)
Number of daily meals & snacks												
≤3	40.5	21.6	14.3	0.004	3.85 (1.58-9.39)**	7.97 (2.03-31.28)**	51.1	40.9	32.8	0.085	1.79 (0.91-3.52)	0.38 (0.10-1.39)
4	28.6	33.5	43.6		0.89 (0.38-2.12)	1.16 (0.36-3.72)	24.4	31.9	39.1		0.72 (0.35-1.49)	0.27 (0.09-0.84)*
≥5	31.0	44.9	42.1		1.00 (ref.)	1.00 (ref.)	24.4	27.2	28.1		1.00 (ref.)	1.00 (ref.)
Media screen time												
<2 h/d	12.5	13.0	21.1	0.182	0.42 (0.14-1.26)	0.71 (0.17-3.03)	10.8	16.7	29.4	0.000	0.19 (0.08-0.45)***	0.34 (0.10-1.17)
≥2-<4 h/d	40.0	43.9	45.3		0.62 (0.29-1.35)	0.63 (0.22-1.82)	33.7	38.9	42.1		0.41 (0.22-0.78)**	0.53 (0.20-1.37)
≥4 h/d	47.5	43.0	33.6		1.00 (ref.)	1.00 (ref.)	55.4	44.4	28.6		1.00 (ref.)	1.00 (ref.)

Table 4. *Continued*

Variable	Boys Low (%)	Boys Mid (%)	Boys Optimal (%)	Boys ***P***†	Boys Low (0-3) *v.* optimal (8-12) quality diet: Crude OR (95% CI)‡	Boys Low (0-3) *v.* optimal (8-12) quality diet: Adjusted OR (95% CI)§	Girls Low (%)	Girls Mid (%)	Girls Optimal (%)	Girls ***P***†	Girls Low (0-3) *v.* optimal (8-12) quality diet: Crude OR (95% CI)‡	Girls Low (0-3) *v.* optimal (8-12) quality diet: Adjusted OR (95% CI)§
Attention to mass media (TV + radio)												
Yes	81.4	70.7	67.7	0.227	2.09 (0.89-4.89)	2.42 (0.75-7.81)	93.3	78.3	61.7	0.000	8.68 (3.53-21.39)***	9.80 (2.59-37.03)**
No	18.6	29.3	32.3		1.00 (ref.)	1.00 (ref.)	6.7	21.7	38.3		1.00 (ref.)	1.00 (ref.)
Physical activity												
Inactive	27.5	25.8	19.1	0.302	1.61 (0.71-3.65)	1.76 (0.53-5.80)	61.6	51.6	36.8	0.001	2.76 (1.57-4.86)***	2.42 (1.03-5.68)*
Active	72.5	74.2	80.9		1.00 (ref.)	1.00 (ref.)	38.4	48.4	63.2		1.00 (ref.)	1.00 (ref.)
Breakfast habit												
Yes	72.1	77.7	85.7	0.273	0.41 (0.11-1.54)	1.31 (0.19-9.22)	37.8	64.6	78.1	0.000	0.13 (0.06-0.30)***	0.06 (0.02-0.27)***
Occasionally	18.6	14.4	9.8		0.92 (0.20-4.31)	1.41 (0.18-11.04)	31.1	21.4	13.3		0.65 (0.26-1.63)	0.43 (0.11-1.75)
No	9.3	7.9	4.5		1.00 (ref.)	1.00 (ref.)	31.1	13.9	8.6		1.00 (ref.)	1.00 (ref.)
Desire to change weight												
To be thinner	25.0	29.5	28.9	0.925	0.74 (0.30-1.86)	0.16 (0.02-1.07)	58.0	51.4	52.3	0.546	0.68 (0.24-1.88)	2.31 (0.43-12.38)
To remain the same weight	43.2	40.1	43.8		0.85 (0.38-1.91)	0.94 (0.30-2.97)	31.8	40.4	41.4		0.47 (0.16-1.35)	1.51 (0.30-7.52)
To be thicker	31.8	30.4	27.3		1.00 (ref.)	1.00 (ref.)	10.2	8.2	6.3		1.00 (ref.)	1.00 (ref.)

Abbreviations: OR, odds ratio; CI, confidence interval; ref.: reference.
†Significant differences between KIDMED index scores by χ^2 test.
‡Univariate analysis (logistic regression analysis considering the effect of one explanatory variable). Significant differences: *P<0.05; **P<0.01; ***P<0.001.
§Multivariate analysis (multiple logistic regression analysis considering the simultaneous effect of all explanatory variables). Significant differences: *P<0.05; **P<0.01; ***P<0.001.
Only adolescents who did not mis-report their energy intake were considered for this analysis.

Table 5. Association between consumption of selected food groups and compliance with Mediterranean Diet Quality Index (KIDMED) among adolescents' from the Balearic Islands, Spain, 2007-2008

Food groups	Frequency categories	Low	Mid	Optimal	*P*‡	Mid v. Low Adjusted OR (95% CI)§	Optimal v. Low Adjusted OR (95% CI)§	Optimal v. Mid Adjusted OR (95% CI)§
Dairy products								
Milk†	≥7 t/w v. <7 t/w (ref.)	50.4	72.4	82.5	0.000	2.01 (1.09-3.69)*	2.37 (0.93-6.02)	1.10 (0.66-1.83)
Yogurt & cheese	≥7 t/w v. <7 t/w (ref.)	44.1	62.7	79.7	0.000	1.72 (0.98-3.02)	5.48 (2.05-14.67)**	1.88 (1.20-2.95)**
Dairy desserts	≥2 t/w v. 2 t/w (ref.)	69.3	69.6	71.3	0.868	0.91 (0.49-1.70)	0.76 (0.28-2.06)	0.91 (0.57-1.45)
Meat								
Red meat†	≥2 t/w v. 2 t/w (ref.)	52.0	49.6	47.4	0.692	1.20 (0.68-2.14)	0.57 (0.22-1.45)	0.82 (0.54-1.26)
Poultry & rabbit†	≥2 t/w v. 2 t/w (ref.)	15.0	15.3	15.1	0.994	1.47 (0.65-3.29)	0.51 (0.11-2.37)	0.67 (0.36-1.23)
Sausages†	≥5 t/w v. ≤4 t/m (ref.)	48.0	51.6	49.4	0.713	0.93 (0.46-1.85)	1.73 (0.55-5.40)	1.07 (0.63-1.82)
	2-4 t/w v. ≤4 t/m (ref.)	22.8	23.7	29.9	0.144	1.12 (0.51-2.46)	3.57 (1.07-11.90)*	1.83 (1.04-3.22)*
	≤4 t/m (ref.)	29.1	24.7	20.7	0.182			
Fish & seafood†	≥2 t/w v. 2 t/w (ref.)	11.0	13.0	28.3	0.000	0.73 (0.30-1.74)	0.86 (0.26-2.83)	1.48 (0.88-2.49)
Eggs†	≥2 t/w v. 2 t/w (ref.)	24.4	26.9	35.1	0.033	1.00 (0.51-1.95)	1.25 (0.43-3.58)	1.08 (0.68-1.72)
Legumes	≥2 t/w v. 2 t/w (ref.)	18.1	13.7	27.4	0.000	0.81 (0.38-1.73)	3.06 (0.98-9.58)	1.96 (1.18-3.26)*
Cereals, grains & products								
Bread†	≥7 t/w v. <7 t/w (ref.)	77.2	84.1	87.7	0.030	1.11 (0.57-2.17)	1.17 (0.36-3.78)	1.28 (0.68-2.42)
Breakfast cereals†	≥5 t/w v. <5 t/w (ref.)	21.3	37.3	51.6	0.000	1.67 (0.86-3.24)	4.90 (1.81-13.28)**	1.63 (1.08-2.48)*
Biscuits	≥5 t/w v. <5 t/w (ref.)	12.6	20.1	31.7	0.000	2.97 (1.64-5.38)***	5.08 (1.89-13.66)**	1.25 (0.83-1.88)
Pasta & rice dishes	≥5 t/w v. <5 t/w (ref.)	15.0	19.0	20.2	0.455	2.21 (0.93-5.29)	1.60 (0.38-6.76)	0.66 (0.38-1.15)
Pizza†	≥2 t/w v. 2 t/w (ref.)	15.0	13.3	13.9	0.886	0.87 (0.39-1.96)	1.15 (0.26-5.09)	0.75 (0.40-1.39)
Fruits								
Fresh fruits†	≥2/day v. 2/day (ref.)	10.2	26.8	48.8	0.000	2.72 (1.14-6.49)*	5.08 (1.58-16.38)**	1.74 (1.15-2.65)**
Fruit juices	≥7 t/w v. <7 t/w (ref.)	34.6	52.0	59.9	0.000	1.63 (0.90-2.94)	2.43 (0.90-6.51)	1.49 (0.98-2.26)
Canned fruits	≥2 t/w v. <2 t/w (ref.)	3.1	5.8	9.9	0.025	3.04 (0.58-15.99)	1.68 (0.19-14.81)	1.31 (0.62-2.80)
Vegetables†	≥2/day v. <2/day (ref.)	8.7	6.5	19.4	0.000	0.33 (0.11-1.04)	0.87 (0.21-3.67)	3.29 (1.71-6.33)***
Nuts†	≥2 t/w v. 2 t/w (ref.)	22.0	28.4	38.9	0.001	1.28 (0.66-2.48)	4.40 (1.47-13.24)**	1.87 (1.21-2.89)**
Potatoes & tubercles†	≥2 t/w v. 2 t/w (ref.)	40.9	36.3	41.7	0.300	1.10 (0.61-2.00)	0.75 (0.28-2.05)	1.25 (0.81-1.93)
Fats								
Olive oil	≥7 t/w v. <7 t/w (ref.)	37.0	50.4	63.7	0.000	1.24 (0.70-2.21)	2.43 (0.95-6.22)	1.64 (1.08-2.49)*
Others oils & fats	≥2 t/w v. <2 t/w (ref.)	33.9	37.4	39.4	0.570	0.98 (0.55-1.76)	0.65 (0.26-1.67)	1.16 (0.76-1.78)

Table 5. *Continued*

Food groups	Frequency categories	Low	Mid	Optimal	*P*‡	Mid v. Low Adjusted OR (95% CI)§	Optimal v. Low Adjusted OR (95% CI)§	Optimal v. Mid Adjusted OR (95% CI)§
High fat foods	≥5 t/w v. ≤4 t/m (ref.)	59.1	42.6	29.9	0.000	0.17 (0.07-0.37)***	0.11 (0.03-0.40)**	0.58 (0.34-1.00)
	2-4 t/w v. ≤4 t/m (ref.)	22.0	28.2	30.7	0.209	0.47 (0.21-1.08)	0.34 (0.09-1.22)	0.93 (0.51-1.94)
	≤4 t/m (ref.)	18.9	29.2	39.4	0.000			
Drinks								
Soft drinks	≥5 t/w v. ≤4 t/m (ref.)	58.3	50.5	43.7	0.023	0.66 (0.35-1.26)	0.26 (0.08-0.84)*	0.72 (0.45-1.17)
	2-4 t/w v. ≤4 t/m (ref.)	11.0	10.5	11.9	0.855	1.10 (0.42-2.92)	0.41 (0.09-1.90)	0.99 (0.51-1.94)
	≤4 t/m (ref.)	30.7	38.9	44.4	0.034			
Tea & coffee	≥2 t/w v. 2 t/w (ref.)	16.5	13.2	19.0	0.105	0.73 (0.33-1.62)	1.74 (0.56-5.43)	2.20 (1.23-3.95)**
Alcoholic beverages	≥1 t/w v. <1 t/w (ref.)	8.7	5.8	5.1	0.379	1.76 (0.58-5.39)	1.17 (0.14-9.81)	0.70 (0.28-1.73)
Other groupings								
Sweets	≥5 t/w v. ≤4 t/m (ref.)	74.8	76.1	78.1	0.739	1.32 (0.51-3.46)	2.07 (0.43-9.94)	0.97 (0.48-1.97)
	2-4 t/w v. ≤4 t/m (ref.)	14.2	13.2	13.5	0.957	1.00 (0.35-2.92)	3.43 (0.53-22.23)	1.13 (0.50-2.53)
	≤4 t/m (ref.)	11.0	10.8	8.4	0.554			
Chocolates	≥5 t/w v. ≤4 t/m (ref.)	21.3	21.7	15.5	0.119	0.96 (0.44-2.10)	0.38 (0.11-1.25)	0.80 (0.46-1.40)
	2-4 t/w v. ≤4 t/m (ref.)	13.4	11.2	11.1	0.764	0.58 (0.25-1.34)	0.47 (0.13-1.70)	1.47 (0.78-2.79)
	≤4 t/m (ref.)	65.4	67.1	73.4	0.148			

Abbreviations: CI, confidence interval; ref., reference; t/w, times/week; t/m, times/month.
† Food consumption cut-offs according to Lazarou et al. [Lazarou et al, 2009a,b]
‡ Significant differences between KIDMED index scores by χ^2 test.
§Multivariate analysis (multiple logistic regression analysis considering the simultaneous effect of all explanatory variables) adjusted by sex, age, parental educational level, parental socio-economic status, body composition, number of daily meals & snacks, media screen time, attention to mass media (TV + radio), physical activity, breakfast habit and desire to change weight. Significant differences: **P*<0.05; ***P*<0.01; ****P*<0.001.
Only adolescents who did not mis-report their energy intake were considered for this analysis.

Manuscrit IX

Diet quality (DQI-I) of Balearic Islands' adolescents: socioeconomic, lifestyle and body image determinants.

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Diet quality (DQI-I) of Balearic Islands' adolescents: socio-economic, lifestyle and body image determinants

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Abstract

Background: Epidemiological evidence suggests that dietary patterns in the Mediterranean countries are changing rapidly.

Objective: The aim of the present study was to evaluate the diet quality of Balearic Islands adolescents by a Mediterranean adaptation of the Diet Quality Index-International (DQI-I), as well as to assess socio-economic, lifestyle and body image determinants.

Methods: Cross-sectional nutritional survey carried out (2007-2008) in the Balearic Islands, a Mediterranean region. A random sample (n=1,231) of the adolescent population (12-17 years old) was interviewed. DQI-I was designed according to the method of Kim *et al.* modified by *Tur et al.* and Mariscal-Arcas *et al.* for Mediterranean populations. It focused on four main characteristics of a high-quality diet (variety, adequacy, moderation and overall balance).

Results: The total score of the DQI-I was 50.6% of the possible score, indicating that the Balearic Islands adolescents' diet was a poor-quality diet. A higher DQI-I score was inversely associated with age, time spent on use media-screen and attention to mass-media during mealtime and directly associated with parental educational level, physical activity, time spent on homework and desire to change weight. Multivariate analysis showed that time spent on media-screen and desire to change weight were the main factors associated with diet quality.

Conclusions: The adolescent Balearic Islands' diet is a poor-diet quality. Food pattern of Balearic Islands' adolescents is in a transitional state characterized by the loss of the traditional Mediterranean dietary pattern. Physical activity and sedentary pursuits are

factors associated with diet quality. Moreover, body image is a powerful determinant of adolescent diet quality, rather than body composition.

Keywords: Diet Quality Index-International (DQI-I), Adolescents, Balearic Islands

Introduction

Adolescence is a transitional stage during which many changes take place at physiological and behavioral levels, representing an important life stage for the development of healthy nutrition behavior [1]. Many different factors influence food habits in a complex interactive way [2]. Socio-economic and lifestyle factors (parental occupational status, maternal level of education, cultural and/or religious habits, the role of family, and patterns of beauty) have a strong influence on eating habits in adolescents [3].

Epidemiological evidence suggests that dietary patterns in the Mediterranean countries are changing rapidly, with an increased consumption of animal products and saturated fat and a decline of intake of basic foodstuffs based on vegetables [4 Because there is evidence that nutritional behaviors track from adolescence into adulthood, the promotion of healthy nutrition during adolescence has the potential to confer significant long-term health benefits [1].

Despite the worldwide promotion of the Mediterranean dietary pattern, a progressive shift to a non-Mediterranean pattern could be also developing among Balearic Islands' adolescents. Therefore, the aim of the present study was to evaluate the diet quality of Balearic Islands adolescents by a Mediterranean adaptation of the Diet Quality Index-International (DQI-I), as well as socio-economic, lifestyle and body image determinants.

Material and methods

Study design

The study is a population-based cross-sectional nutritional survey carried out in the Balearic Islands (2007-2008).

Selection of participants, recruitment and approval

A multicenter study was performed on Balearic Islands' adolescents aged 12–17 years. The population was selected by means of a multiple-step, simple random sampling, taking into account first the location (Palma de Mallorca, Calvià, Inca, Manacor, Maó, Eivissa, Llucmajor, Santa Margalida, S'Arenal, Sant Jordi de Ses Salines) and then by random assignment of the schools within each city. Sample size was stratified by age and sex. The socioeconomic variable was considered to be associated to geographical location and type of school. As the selection of schools was done by random selection and fulfilling quota, this variable was also considered to be randomly assigned.

To calculate the number of adolescents to be included in the study in order to guarantee a representative sample of the whole Balearic Islands, we selected the variable with the greatest variance for this age group from the data published in the literature at the time the study was planned; that was BMI [5]. The sampling was determined for the distribution of this variable; the CI was established at 95% with an error ± 0.25. The established number of subjects was 1,500. The total number of subjects was uniformly distributed in the cities and proportionally distributed by sex and age group.

The sample was oversized to prevent loss of information and as necessary to do the fieldwork in complete classrooms. In each school, all the adolescents of one classroom were proposed to participate in the survey. A letter about the nature and purpose of the study informed parents or legal tutors. After receiving their written consent, the adolescents were considered for inclusion in the study. After finishing the field study, the adolescents who did not fulfill the inclusion criteria were excluded. Finally, the sample was adjusted by a weight factor in order to balance the sample in accordance to the distribution of the Balearic Islands' population and to guarantee the representativeness of each of the groups, already defined by the previously mentioned factors (age and sex). The final number of subjects included in the study was 1,231 adolescents (82% participation). The reasons to not participate were (a) the subject declined to be interviewed, and (b) the parents did not authorize the interview.

This 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 (Palma de Mallorca, Spain).

Dietary assessment

Dietary questionnaires included two non-consecutive 24 hour diet recall periods, one in the warm season (May-September) and one in the cold season (November-March) to account for the influence of seasonal variations, and a semi-quantitative food-frequency questionnaire (FFQ) that has previously been validated [6] and applied in other studies and surveys over the Spanish population [7-11]. The FFQ, which asked the participant 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) 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. The period of consumption of seasonal items was also considered. Edible fractions of foods were recorded in the database. To account for day-to-day intake variability, the questionnaires were administered homogeneously from Monday to Sunday. Well-trained dietitians administered the recalls and verified and quantified the food records.

To estimate volumes and portion sizes, the household measures found in the subjects' own homes were used. Conversion of food into nutrients was made using a self-made computerised program (ALIMENTA®; NUCOX, Palma, Spain) based on Spanish [12,13] and European [14] food composition tables, and complemented with food composition data available for Majorcan food items [15]. Identification of mis-reporters was conducted on the basis of the ratio of energy inatke (EI) to BMR. EI:BMR <0.92 (boys) and <0.85 (girls) was considered to represent underreporting [16], while EI:BMR≥2.4 was considered to represent over-reporting [17,18]. Under-reporters (20%) and over-reporters (2%) were excluded from the analysis.

Diet Quality Index-International (DQI-I)

The DQI-I modified by Mariscal-Arcas *et al.* [19] following the Tur *et al*. [20] modification of the method developed by Kim *et al.*[21] was applied to assess the diet quality of the Balearic Islands adolescents. The DQI-I focuses on four aspects of a high-quality diet (variety, adequacy, moderation and overall balance). Under each of these categories there are specific components of diet that are assessed. These categories help users to identify aspects of their diet that may need improvement. The scores for each component 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 (see Table 1). The scoring system is described in Table 2.

Variety. Variety in the diet was evaluated as overall variety and as variety of protein sources. The maximum overall variety score was achieved by intake of at least one serving per day from each of the five food groups (meat/poultry/fish/egg, dairy/beans, grains, fruit and vegetables). The score for the variety of protein sources (meat, poultry, fish, dairy, beans and eggs) was based on intakes of more than half the service size per day.

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, gain and fibre intake is dependent on the energy intake.

Thus, for energy intakes of 7118 kJ (1700 kcal), 9211 kJ (2200 kcal) or 11304 kJ (2700 kcal), the maximum score is assigned to a diet containing 2, 3 or 4 portions of fruit and 3, 4 or 5 portions of vegetables, respectively. Likewise, the highest score for grain and fiber categories was assigned to daily intakes of ≥6, ≥9 and ≥11 portions of grain and ≥20, ≥25 and ≥30g of 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 [13], which vary according to age and gender.

Moderation. This category evaluates the intake of food and nutrients related to chronic diseases, which may need restriction. To emphasize the importance of moderation in fat intake, total fat intake in the DQI-I is evaluated using more stringent cut-off values than those found in other dietary indexes. A score of 6 points was assigned when total fat was ≤30% of total energy/d, 3 points when 30–35% of total energy/d and 0 points when >35% of total energy/d [19,20]. The intake of saturated fats was also evaluated as the percentage of energy from saturated fat. Intake levels of cholesterol and sodium were also recorded. 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. Despite that the DQI-I states that table sugar, alcohol, oil and similar are empty calorie foods (if the sum of nutrient densities considered across nutrients in a food is <1, the food is considered an empty-calorie food); the following were only categorized in the MPD food pyramid as empty-calorie foods if their use was only ‘occasional and moderate’ [22]: cold meats, pâte´, 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 [19] (Table 2).

Overall balance. This category examines the overall balance of diet in terms of proportions of energy sources and fatty acid composition. Detailed cut-off values and corresponding scores as proposed by Tur *et al.* [20] are described in Table 2.

Assessment of other co-variables

Sociodemographic and lifestyle variables

A questionnaire incorporating the following questions was used: age group; parental educational level (grouped according to years and type of education: low, <6 years at school; medium, 6-12 years of education; high, >12 years of education); parental socio-economic level (based on the occupation of parents and classified as low, medium and high, according to the methodology described by the Spanish Society of Epidemiology [23].

The number of daily meals and snacks was calculated using the total of eating occasions that subjects declared to made among the following: breakfast; mid-morning snack; lunch; mid-afternoon snack; dinner; before going to sleep; others. Three groups of eating frequency were considered: ≤3, 4, and ≥5 times/d.

Information about consumption and breakfast habits, time spent on breakfast, lunch and dinner were collected as described: breakfast daily (yes; occasionally; no), time spent on breakfast, lunch and dinner (<10 min; 10-20 min; >20 min).

Distraction during mealtime was studied using different possibilities: (1) watching the TV; (2) listen to the radio; (3) get up from the table; (4) conversation during mealtime. These variables were joined and expressed as (1) attention to mass media (TV + radio); (2) others.

Anthropometry measurements

Height was determined using a mobile anthropometer (Kawe 44444, Asperg, Germany) to the nearest millimetre, with the subject's head in the Frankfurt plane. Body weight was determined to the nearest 100g using a digital scale (Tefal, sc9210, Rumilly, France). The subjects were weighed in bare feet and light underwear. The subjects were asked to stand erect in a relaxed position with both feet together on a flat surface. Triceps and subscapular skinfold thickness (ST) were measured at the right side of the using a Holtain skinfold calliper (Tanner/Whitehouse, Crosswell, Crymych, UK), and the mean of three measurements was used. Height and weight measures were used to calculate body mass index (BMI, kg/m^2). Body fat percentage (%BF) was measured from triceps and subscapular ST according to Slaughter *et al.* [24]. This equation has been proposed as the most accurate for estimation of %BF from ST in this particular population of adolescents [25]. %BF and height were used to calculate fat mass index (FMI; kg/m^2).

Defining overweight and obesity

In children and adolescents, BMI for age has been established as the main measurement to define overweight and obesity [26]. However, there are some limitations associated with its use as an indicator of fatness. For example, individuals with increased muscle mass may also have increased BMI [27]. On the other hand, individuals with decreased lean body mass and increased adiposity may also be misclassified by assessment with BMI [27]. Alvero-Cruz *et al.* [28] showed that the FMI had higher accuracy for overweight screening than BMI. The FMI is a useful measure to evaluate body composition parameters by effectively eliminating differences in body fat associated with height [29]. Nevertheless, it is difficult to exclude BMI from the normal-weight and overweight definition. For this reason, a combination of BMI and FMI was used to define overweight and obesity in the present study.

First, subjects were classified using the age- and sex-specific cut-offs developed and proposed for international comparisons by Cole *et al.* [30], recommended for use also by the International Obesity Task Force. Then, subjects were classified as normal-fat and overfat according to their FMI using the sex-specific cut-offs proposed by Alvero-Cruz *et al.* [28] for adolescents: 4.58 kg/m^2 in boys and 7.76 kg/m^2 in girls. Thus, adolescents were classified into three groups as follows: (i) normal-fat (BMI for age and sex <25 kg/m^2; FMI<4.58 kg/m^2 in boys, FMI<7.76 kg/m^2 in girls); (ii) overweight (BMI for age and sex ≥25-<30kg/m^2; FMI≥4.58 kg/m^2 in boys, FMI≥7.76 kg/m^2 in girls); (iii) obesity (BMI for age and sex ≥30-BMI kg/m^2; FMI≥4.58 kg/m^2 in boys, FMI≥7.76 kg/m^2 in girls). The variable was labeled as 'body composition' [31].

Assessment of physical activity

Physical activity was evaluated according to the guidelines for data processing and analysis of the international physical activity questionnaire (IPAQ) [32] in the short form and its specific modification for adolescents (IPAQ-A) [33]. The specific types of activity assessed were walking, moderate-intensity activities (i.e. physical activity at school), and vigorous-intensity activities (i.e. sport practice). In accordance with the AVENA (Food and Assessment of Nutritional Status of Adolescents) study [34], the questionnaire also included information on television (TV) viewing, computer use and video games and homework in h/d to the nearest 10 min. Physical inactivity was established with a cut-off level of 300 min/week of moderate/vigorous physical activity, in accordance with recent reports of physical activity for adolescents [35,36].

Body image

Perceived body image was measured using the Stunkard scale [37], which consists of silhouette drawings ranging from 1 to 9 with monotonic increments in overweight percentage where 1 is the leanest and 9 is the heaviest. Separate figures for boys and girls were used. Participants were asked to identify of the 9 body figures: (a) 'Which silhouette looks most like yourself?' and (b) 'Which silhouette would you like to look like?' The difference between perceived body image and desired body image was used to determine the level of dissatisfaction with current body image. Values other than zero represent dissatisfaction with perceived body image. A positive value was indicative of the participant's desire to be thinner than his/her perceived current size, while a negative value reflected the participant's desire to be thicker than his/her current perceived size [38,39].

Statistics

Analyses were performed with Statistical Package for the Social Sciences version 19.0 (SPSS, Inc., Chicago, IL, USA). Scores of the modified DQI-I and its four main categories were expressed as the mean and score obtained for each component of the DQI-I, and the percentage of the population for each component subcategory was calculated. ANOVA, univariate and multivariate linear regression analysis were used to assess the association between modified DQI-I scores and values of socioeconomic, dietary habits, lifestyle, body composition and body image variables. The level of significance was established for *P* values <0.05.

Results

The mean total modified DQI-I score was approximately 50.6% of the possible score (100%). The best achieved score was for the variety one, followed by the adequacy and moderation scores. Overall balance was the weakest area of the diet, according to the modified DQI-I (Table 1).

Regarding the variety category, 71.6% of adolescents daily consumed at least one serving from each food (24.5%) or missed only one food group (47.1%), and 80.5% had three or more different sources of protein per day (Table 2). When the adequacy category is analysed, we can observe that a large proportion of the population reported an intake of fruit, proteins, iron and vitamin C that were 50% higher than recommendations. However, slightly more than half of population reported an intake of grain group, fibre and calcium that were 50% higher than recommendations, and most of adolescents failed to meet the recommended levels of vegetable. In the moderation category, only 10.3% and 3.0% of adolescents achieved the fat and saturated fat goals, respectively. Cholesterol intake was ≤300 mg/d in 45.1% of the population and >400 mg/d in 33.3%. Around 53% of the population met the goal for sodium intake. Only 1.6% of the population consumed empty-calorie foods less than five times a week. A very poor balance was found for energy-yielding nutrients as well as among fatty acids.

Comparative analysis of socioeconomic, dietary habits, lifestyle, body composition and body image, with the modified DQI score as dependent variable, showed a significant relationship between score and: age; parental educational level, with best scores for adolescents of parents with high educational level; distraction during mealtime, with lower DQI-I mean score for those adolescents who attended to mass media (TV+radio) during mealtime; physical activity level, with better mean score for active than sedentary individuals; time spent on homework, with better mean score for those who reported to dedicating more time to homework; time spent on TV or computer use, with best scores for adolescents who spent less than 2 hours daily; and desire to change weight, with lower mean score for those who desired a thicker body shape (Table 3). In a subsequent univariate linear regression analysis the same variables continued to show a significant relationship with DQI-I score. A multivariate analysis showed that time spent on dinner, physical activity level, time spent on homework, time spent on use TV and computer use, and desire to change weight were associated with the DQI-I score (despite that only time spent on media screen and desire to change weight were significantly associated); while there was no significant relationship with sex, age, parental educational level, parental socio-economic status, body composition, eating frequency, breakfast habit, time spent on breakfast and lunch, and attention to mass media during mealtime.

Discussion

In the present study, the modified DQI-I [19] was used to evaluate the diet quality in a representative sample of the adolescent Balearic Islands population with the aim of ascertaining possible nutritional problems related to the nutrition transition that may occurring in the Mediterranean-type, which is especially common among young generations. However, it is important to note that the use of a single diet quality score for international comparison is problematic [19]. For dietary recommendations to be relevant and suitable for a given population, they should take account of prevailing food patterns in that population [19,20,40-46].

The mean DQI-I score obtained for the Balearic Islands adolescents was 50% of the full score, which is more lower than the mean scores reported in the USA and China in 1993-96 (≥20 years old) [21] and also southern Spain in 1999-2000 (6-18 years old) [19], but higher than mean scores observed in adult Balearic population (16-65 years old) in 1999-2000 [20]. According to the criteria of Kim *et al.* [21], scores below 60% indicate a poor-quality diet, but it is arguable whether DQI-I criteria for high-quality diets are wholly applicable to Mediterranean-type diets [19,20].

In the present population, adequacy and variety had the highest scores as also found in adult Balearic Islands population [20] and children and adolescents in southern Spain [19]. Adequacy reflects compliance with prevailing recommendations to ensure a healthy diet. The diet of the present population was assigned a high average score in this category for adequate intakes of fruit, protein, iron and vitamin C but a low score for intake of vegetables and calcium. Mariscal-Arcas *et al.* [19] observed a high score for intake of protein, iron but also calcium, and a low score for intake of fruit, vegetables, grain and fibre among children and adolescents in southern Spain.

Variety in the diet was evaluated as overall variety and variety within protein sources. The DQI-I assumes that a diet including various protein sources is also a feature of a good varied diet [19]. However, it may be questionable whether variety of animal food sources of dietary protein in cultures where animal foods are routinely consumed. Moreover, as have been observed previously by Balearic Islands' adolescents is undergoing a change in dietary patterns [31] and therefore, protein variety may actually higher due to changes in traditional protein sources [20]. On the other hand, Tur *et al.* [20] also found that overall food group variety correlated better with adherence to the Mediterranean diet pattern than did protein source variety scores. Therefore, it may be more appropriate to use other food group for this measure of variability, such as vegetables, fruit or grain [19,20].

In agreement with adult Balearic Islands population [19], according to the DQI-I score adolescents' diet is characterized by lack of moderation and it is highly unbalanced. Scores obtained for moderation in total fat and saturated fat consumption were very poor [19,20]. The DQI-I sets strict standards, especially for fat intake, in line with US recommendations. The DQI-I establishes moderate fat consumption as <30% of total energy, lower than the percentage found in the Spanish diet. In fact only 10.3% of Balearic Islands adolescents had a fat intake at or below 30% of energy intake, similar than in adults (14.5%) [19]; being the current fat content of the Balearic adolescent diet 39% (SD 7.34) of total energy intake. It is known that total fat intake in Mediterranean countries is in the range of 38-40%, close to that of northern countries, whereas incidence of cardiovascular diseases and diet-related cancer is lower [44,47]. The olive oil is the central elemental of Mediterranean-type diets, a key contributor to its healthy properties and their consumption promotes the intake of vegetables in the Mediterranean area [48,49]. Therefore, as have been suggested previously [19,20] quality rather than the quantity of fat (e.g. reducing saturated fat but not of olive oil consumption [40,41]) should be take into account in dietary evaluations and guidelines.

In agreement with a previous study [19], high energetic foods were only classified as empty-calorie foods when their use was only occasional and moderate, as recommended in the food pyramid for the Spanish population [22]. Thus, olive oil which contains a higher proportion of MUFA, vitamin E and a lot of antioxidant phenolic compounds [50-52] was not included in the empty calorie food group category. However, as have been previously suggested previously [19,20] further research should be carried out to establish a moderation indicator better suited to Mediterranean populations.

The proportionally in energy sources and fatty acid composition is examined by overall balance category. The present population had a mean macronutrient ratio of 45:29:38 (carbohydrate:protein:fat), and very few individuals met the goal of 55-65% of energy from carbohydrate (8.8%), 10-15% from protein (0.5%) and 15-30% from fat (10.3%). The mean ratio of PUFA and MUFA to SFA was 1.68 (SD 0.54), higher to previous findings in adults of the Balearic Islands [20] and southern Spain [19]. Moreover, in the present population about 17% of total energy was from MUFA and 4% from PUFA. The Spanish Nutritional Objectives recommended 20% of total energy from MUFA and 5% from PUFA [40,41], being olive oil the main source of unsaturated fat in the Mediterranean area.

The literature has reported that girls paid more attention to foods than boys, met nutritional recommendations, and tried to prevent or reverse the obese state and improve health status [52]. In the present study no sex differences in DQI-I mean score were found; however, previously we identified two major dietary patterns among adolescents (‘Western’ and ‘Mediterranean’ dietary patterns) [31], supporting evidence for a nutrition transition from a traditional healthy diet towards a Western diet among Balearic Islands’ youth, and being girls more likely to follow the ‘Mediterranean’ dietary pattern but not the ‘Western’ dietary pattern than boys.

Socioeconomic and lifestyle characteristics are important determinants of the health status in a community. Parental educational level and socioeconomic status have a marked effect on children’s and adolescent’s lifestyles and dietary habits [54]. In previous studies, we found that maternal educational level was associated with diet quality [55] and adherence to the Mediterranean dietary pattern [56].

Despite finding no significant association between number of daily meals & snacks, breakfast habit and time for the main meals (breakfast, lunch and dinner) and DQI-I, meal pattern and omission of meals, especially skipped breakfast, have been suggested as markers of an inappropriate dietary intake among adolescents [57], and in a previous study eating frequency was identified as a risk factor for obesity in both boys and girls [58]. A promotion of at least 5 daily meals & snacks should be considered in nutrition education programmes for adolescents aimed at reducing risk of disease. However, education programmes could also focus on strategies to promote healthy food choices following the Mediterranean diet.

Physical activity level has been associated with food choice, and cereals, fruits and vegetables often appear in the diet of active adult and children [59]. Children who follow a healthy diet are those who might also maintain high levels of physical activity [60]. In a previous study we found that sedentary and low-active adolescents showed the lowest adherence to the Mediterranean dietary pattern [56]. In the present study, active adolescents also showed a higher DQI-I score. However, children and adolescents usually spend much leisure-time on sedentary behaviours, as TV viewing, computer and video-games, collectively known as media screen time [61]. An association between >2 h/d watching TV and major consumption of high-fat snacks and high-sugar drinks has been demonstrated [62,63]. TV is clearly related to exposure to the advertising of unhealthy foods [52]. Previously, we have also reported that despite the lack of statistical significant differences when TV and computer use were assessed separately, media screen time is a good proxy for dietary pattern [31]. Overall, adolescents who spent ≥4 h/d on media-screen were more likely to follow a 'Western' dietary pattern; whereas those who spent <2 h/d showed the highest probability for a 'Mediterranean' dietary pattern [31]. Accordingly, adolescents who spent ≥4 h/d on media screen showed a lower DQI-I than those who spent <2 h/d. Nevertheless, adolescents who spend ≥3 h/d to homework had the highest DQI-I score mean. Therefore, it is important to note that sedentary pursuits are related to diet quality. Thus, while time spent on use media-screen was inversely associated with diet quality, time spent on homework was directly associated with diet quality.

Our results also suggest that is self-perception rather than body composition that is more closely related to diet quality. In fact, body image has been found to be a powerful determinant of adolescent nutritional habits and food choices [64]. Therefore, understanding how satisfaction with current body shape affects the food preferences and overall adolescent diet is a key issue for the development of strategies aimed at influencing dietary behavior.

Limitations of the study

Dietary and physical activity data were based on self-reports [65]. The literature reports that food under-reporting is usually associated with gender and weight status [66,67]. Self-report of physical activity also can lead to over-report the physical activity due to social desirability bias, and therefore the number of inactive individuals may be greater than that reported [68,69], especially among children and adolescents, and also among obese [68]. However, in many cases, self-reporting is the only feasible method of assessing physical activity [70] and dietary intake in epidemiological studies. Although epidemiologists made every effort to get as accurate data as possible, there is a possibility that mis-reporting occurred [65].

Body fat was calculated using Slaughter *et al.*'s equations [24] that have been suggested previously by Rodríguez *et al.* [25]. However, the present study did not take into account pubertal development despite that chronological age may vary dramatically during this phase. Therefore, as in a previous study [71] in which adolescents have been classified according to their pubertal stage, boys were divided into two groups: pubertal (12 to 14 years old) and post-pubertal (15 to 17 years old).

Conclusion

The present study shows that the adolescent Balearic Islands' diet is a poor-diet quality. Food pattern of Balearic Islands' adolescents is in a transitional state characterized by the loss of the traditional Mediterranean dietary pattern. Physical activity and sedentary pursuits are factors associated with diet quality. Moreover, it is important to note that body image is a powerful determinant of adolescent nutrition habits and food choices [64], rather than body composition.

Adolescents constitute priority targets for action and should be more aware about the diet quality and its health benefits. Programmes to promote the traditional Mediterranean dietary pattern among not only adolescents but also their families, combined with an active lifestyle would likely result in a more favorable future health profile.

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Authors' contributions

MMB, JP and JAT conceived, designed, devised and supervised the study, MMB, JP and JAT collected and supervised the samples. MMB and JAT analysed the data and wrote the manuscript. AP and JAT obtained funding. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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Table 1. Diet Quality Index-International (DQI-I) scores and components

Component	Score ranges (points)	Mean	SD
DQI-I, total	0-100	50.59	8.95
Variety	0-20	16.18	3.02
Overall food group variety	0-15	11.65	2.64
Within-group variety for protein sources	0-5	4.53	1.05
Adequacy	0-40	23.9	4.44
Vegetable group	0-5	1.18	0.84
Fruit group	0-5	3.06	1.63
Grain group	0-5	2.54	1.56
Fibre	0-5	2.47	1.16
Protein	0-5	5.00	0.00
Iron	0-5	3.65	1.23
Calcium	0-5	2.18	1.19
Vitamin C	0-5	3.77	1.58
Moderation	0-30	9.29	5.48
Total fat	0-6	1.18	2.00
Saturated fat	0-6	0.61	1.41
Cholesterol	0-6	3.35	2.63
Sodium	0-6	3.91	2.43
'Empty calorie foods' (without olive oil)	0-6	0.21	0.93
Overall balance	0-10	1.32	1.69
Macronutrient ratio (carbohydrate:protein:fat)	0-6	0.02	0.26
Fatty acid ratio ((PUFA+MUFA)/SFA)	0-4	1.30	1.66

Abbreviations: PUFA, poly-unsaturated fatty acid; MUFA, mono-unsaturated fatty acid; SFA, saturated fatty acid. Only adolescents who did not mis-report their EI were considered for this analysis.

Table 2. Components of the Diet Quality Index (DQI-I) and percentage of sample in component subcategories

Component	Full	Scoring criteria: Point	Scoring criteria: Criteria	% Population
Variety	0-20			
Overall food group variety	0-15	15	≥1 serving from each food	24.5
		12	Any 1 food group missing/d	47.1
		9	Any 2 food group missing/d	22.1
		6	Any 3 food group missing/d	5.2
		3	≥4 food groups missing/d	0.9
		0	None from any food group	0.2
Within-group variety from protein source	0-5	5	≥3 different sources/d	80.5
		3	2 different sources/d	16.0
		1	From 1 source/d	2.0
		0	None	1.4
Adequacy	0-40			
Vegetable group*	0-5	5	>100% recommendations	2.0
		3	50-100% recommendations	8.6
		1	<50% recommendations	82.2
		0	0% recommendations	7.2
Fruit group*	0-5	5	>100% recommendations	33.9
		3	50-100% recommendations	35.8
		1	<50% recommendations	28.8
		0	0% recommendations	1.6
Grain group*	0-5	5	>100% recommendations	21.4
		3	50-100% recommendations	34.2
		1	<50% recommendations	44.3
		0	0% recommendations	0.1
Fibre*	0-5	5	>100% recommendations	7.0
		3	50-100% recommendations	59.5
		1	<50% recommendations	33.5
		0	0% recommendations	0.0
Protein	0-5	5	>100% recommendations	100.0
		3	50-100% recommendations	0.0
		1	<50% recommendations	0.0
		0	0% recommendations	0.0
Iron†	0-5	5	>100% recommendations	40.2
		3	50-100% recommendations	52.0
		1	<50% recommendations	7.8
		0	0% recommendations	0.0
Calcium†	0-5	5	>100% recommendations	5.6
		3	50-100% recommendations	47.6
		1	<50% recommendations	46.8
		0	0% recommendations	0.0
Vitamin C†	0-5	5	>100% recommendations	57.7
		3	50-100% recommendations	23.1
		1	<50% recommendations	18.9
		0	0% recommendations	0.2

Table 2. *Continued*

		Scoring criteria		%
Component	**Full**	**Point**	**Criteria**	**Population**
Moderation	0-30			
Total fat	0-6	6	≤30% of total energy/d	10.3
		3	>30-35% of total energy/d	18.8
		0	>35% of total energy/d	70.9
Saturated fat	0-6	6	≤7% of total energy/d	3.0
		3	>7-10% of total energy/d	14.1
		0	>10% of total energy/d	82.8
Cholesterol	0-6	6	≤300 mg/d	45.1
		3	>300-400 mg/d	21.7
		0	>400 mg/d	33.3
Sodium	0-6	6	≤2400 mg/d	52.7
		3	>2400-3400 mg/d	25.0
		0	>3400 mg/d	22.3
'Empty calorie food' (without olive oil)	0-6	6	<5 times/week	1.6
		3	>5-10 times/week	3.8
		0	>10 times/week	94.6
Overall balance	0-10			
Macronutrient ratio (carbohydrate:protein:fat)	0-6	6	55-65:10-15:15-30	0.0
		4	52-68:9-16:13-32	0.4
		2	50-70:8-17:12-35	0.0
		0	Otherwise	99.6
Fatty acid ratio ((PUFA+MUFA)/SFA)	0-4	4	>2	23.2
		2	1.7-2	18.7
		0	<1.7	58.2

Abbreviations: PUFA, poly-unsaturated fatty acid; MUFA, mono-unsaturated fatty acid; SFA, saturated fatty acid. Only adolescents who did not mis-report their EI were considered for this analysis.

Table 3. Association between Diet Quality Index (DQI-I) and sociodemographic and body image variables

		DQI		ANOVA*		Univariate linear regression†		
		Mean	**SD**	***F***	***P***	**β**	**(SEM β)**	***P***
Sex	Boys	50.1	8.78	1.657	0.198	0.780	0.606	0.198
	Girls	50.9	9.08					
Age	12-13 years old	51.0	8.42	3.255	0.039	-0.883	0.434	0.042
	14-15 years old	51.1	9.12					
	16-17 years old	49.3	8.98					
Parental educational level	Low	49.8	8.73	3.079	0.047	0.883	0.367	0.016
	Medium	50.3	9.07					
	High	51.6	8.80					
Parental socioeconomic status	Low	50.4	9.69	0.196	0.822	0.286	0.463	0.537
	Medium	50.8	8.72					
	High	51.0	8.63					
Body composition	Normal-fat	50.4	8.99	1.268	0.282	0.461	0.633	0.467
	Overweight	51.9	8.90					
	Obesity	49.9	7.18					
Eating frequency	≤3	50.5	9.03	0.535	0.586	-0.138	0.371	0.710
	4	50.9	8.94					
	≥5	50.2	8.76					
Breakfast habit	Yes	50.6	8.78	0.194	0.824	-0.238	0.436	0.585
	Occasionally	50.2	9.21					
	No	50.3	9.16					
Time spent on breakfast	<10 min	50.4	9.05	1.091	0.336	0.916	0.626	0.144
	10-20 min	51.2	8.19					
	≥20 min	52.6	8.33					
Time spent on lunch	<10 min	49.7	8.83	0.396	0.673	0.307	0.481	0.524
	10-20 min	50.6	8.87					
	≥20 min	50.7	9.01					
Time spent on dinner	<10 min	50.1	8.54	0.743	0.476	0.535	0.459	0.244
	10-20 min	50.4	9.00					
	≥20 min	51.1	9.00					
Attention to mass media (TV+radio)	Yes	50.1	8.99	7.249	0.007	1.834	0.681	0.007
	No	51.9	8.57					
Physical activity level	Active	51.2	8.87	6.670	0.010	-1.612	0.624	0.010
	No active	49.5	8.90					
Time spent on homework	<1 h/d	49.3	8.82	3.796	0.023	1.509	0.554	0.007
	1-3 h/d	50.5	8.79					
	≥3 h/d	52.2	9.32					
Time spent on media-screen	<2 h/d	53.2	9.06	9.492	0.000	-1.769	0.416	0.000
	2-4 h/d	50.7	9.13					
	≥4 h/d	49.4	8.55					
Desire to change weight	To be thinner	51.3	9.20	5.803	0.003	-1.257	0.412	0.002
	To remain the same weight	50.8	8.88					
	To be thicker	48.4	8.29					

*Comparison of mean DQI-I scores among groups by ANOVA.
†Univariate linear regression analysis considering effect of single socio-economic, dietary habit, lifestyle and body image (independent) variables on DQI-I score (dependent variable).
Only adolescents who did not mis-report their EI were considered for this analysis.

Table 4. Results of the final multivariate linear regression analysis of Diet Quality Index (DQI-I) with the significant variables

	Multivariate linear regression		
	β	**(SEM β)**	***P***
Time spent on dinner	0.985	0.584	0.092
Physical activity level	-1.309	0.723	0.071
Time spent on homework	1.023	0.611	0.094
Time spent on media screen	-1.658	0.474	0.001
Desire to change weight	-1.231	0.543	0.024

Only adolescents who did not mis-report their EI were considered for this analysis.

Manuscrit X

Body dissatisfaction among Balearic Islands' adolescents: increasing or decreasing?

Bibiloni MM, Pich J, Pons A, Tur JA.

Body dissatisfaction among Balearic Islands' adolescents: increasing or decreasing?

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Abstract

Background: Recently research also revealed that despite the rise in overweight and obesity prevalence, body dissatisfaction among adolescents may be decreasing

Objective: To assess the prevalence of overweight and obesity according to BMI and fat mass index (FMI) cut-offs for adolescents, and its association to adolescents' self-perception and attitudes toward weight control.

Methods: Two cross-sectional surveys carried out in the Balearic Islands, Spain (2007-08). A random sample (*n*=1961) of the adolescent population (12-17 years old) was interviewed. Anthropometric measurements, questions related to self-perception and attitudes toward weight control, incorporating Stunkards' silhouettes, were used. Adolescents were grouped according to BMI and FMI cut-offs.

Results: Results indicate that in 2007-2008, an estimated 11.9% and 6.1% of adolescents were overweight overfat and obese, respectively. Estimates of 2-academic years later were 12.5% and 5.7%, respectively (P>0.05), although overweight overfat prevalence significantly increased from 7.1% to 10.9% among girls (P<0.05).

Despite that about 22% of normal-weight normal-fat girls preferred to look as silhouette 2, results indicated an increase from 20.9% to 33.1% for desire for a silhouette 4 in them (decreasing desire to look as silhouette 3). Parallel to this result, 2-academic years later normal-weight normal-fat girls were also less worried about weight gain (from 61.7% to 50.2%) and increase percentage of those who reported to have not ever attempted to lose weight (from 41.9% to 50.6%). Among non-overweight boys, results indicate an increase for desire to look as silhouettes 3 and 5.

Conclusions: While normal-weight normal-fat girls may be increasing an acceptation for a slightly higher body shape, into the standard of beauty; a desire for a slim body shape may be increasing among boys.

Keywords: BMI, body fat, FMI, body image, adolescents

Introduction

Body image is a multidimensional phenomenon that includes at least perceptual, cognitive, behavioral, evaluative and affective features [1]. Body image concerns, body dissatisfaction, negative body image, and dissatisfaction with physical appearance are all concepts signifying discontent with some aspect of one's physical appearance, or with appearance overall [2]. Body dissatisfaction is a prevalent reality for many adolescents, in which the rapid bodily development resulting from puberty sometimes difficult task of accepting one's changing body. But, whereas there are quite a number of studies on body image in young adults, there is a paucity of studies on adolescents' body dissatisfaction [3].

Research consistently finds that girls exhibit more body dissatisfaction than boys, being them more likely than boys to judge themselves as too fat when they are actually average-weight, or even under-weight [4]. However, an emerging literature shows that boys also suffer body image disturbances, even at a very young age [5].

Both male and female attractiveness standards espouse slenderness and denigrate overweight. Adolescents are not an exception. But recently research also revealed that despite the rise in overweight and obesity prevalence, body dissatisfaction among adolescents may be decreasing [6].

The aim of the present study was to assess the prevalence of overweight and obesity according to BMI and fat mass index (FMI) cut-offs for adolescents, and its association to adolescents' self-perception and attitudes toward weight control.

Materials and Methods

Study design

The study is a population-based cross-sectional nutritional survey carried out (2007-2008) in the Balearic Islands, a Mediterranean region.

Selection of participants, recruitment and approval

A multicenter study was performed on Balearic Islands' adolescents aged 12–17 years. The population was selected by means of a multiple-step, simple random sampling, taking into account first the location (Palma de Mallorca, Calvià, Inca, Manacor, Maó, Eivissa, Llucmajor, Santa Margalida, S'Arenal, Sant Jordi de Ses Salines) and then by random assignment of the schools within each city. Sample size was stratified by age and sex. The socio-economic variable was considered to be associated to geographical location and type of school. As the selection of schools was done by random selection and fulfilling quota, this variable was also considered to be randomly assigned.

To calculate the number of adolescents to be included in the study in order to guarantee a representative sample of the whole Balearic Islands, we selected the variable with the greatest variance for this age group from the data published in the literature at the time the study was planned; that was BMI [7]. The sampling was determined for the distribution of this variable; the CI was established at 95% with an error ± 0.25. The established number of subjects was 2400. The total number of subjects was uniformly distributed in the cities and proportionally distributed by sex and age group. Exclusion criteria were: type 2 diabetes, pregnancy, alcohol or drug abuse, and non-directly related nutritional medical conditions.

The sample was oversized to prevent loss of information and as necessary to do the fieldwork in complete classrooms. In each school, all the adolescents of one classroom were proposed to participate in the survey. A letter about the nature and purpose of the study informed parents or legal tutors. After receiving their written consent, the adolescents were considered for inclusion in the study. After finishing the field study, the adolescents who did not fulfil the inclusion criteria were excluded. Finally, the sample was adjusted by a weight factor in order to balance the sample in accordance to the distribution of the Balearic Islands' population and to guarantee the representativeness of each of the groups, already defined by the previously mentioned factors (age and sex). The final number of subjects included in the study was 1961 adolescents (82% participation). The reasons to not participate were (a) the subject declined to be interviewed, and (b) the parents did not authorize the interview.

This 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 (Palma de Mallorca, Spain).

Anthropometry measurements

Height was determined using a mobile anthropometer (Kawe 44444, Asperg, Germany) to the nearest millimetre, with the subject's head in the Frankfurt plane. Body weight was determined to the nearest 100g using a digital scale (Tefal, sc9210, Rumilly, France). The subjects were weighed in bare feet and light underwear. The subjects were asked to stand erect in a relaxed position with both feet together on a flat surface.

Triceps and subscapular skinfold thickness (ST) were measured at the right side of the using a Holtain skinfold caliper (Tanner/Whitehouse, Crosswell, Crymych, UK), and the mean of three measurements was used. Body fat percentage (%BF) was measured from triceps and subscapular ST according to Slaughter et al. [8]. This equation has been proposed as the most accurate for estimation of %BF from ST in this particular population of adolescents [9]. Height and weight measures were used to calculate body mass index (BMI, kg/m^2) and WC and height were used to calculate waist-to-height ratio (WHtR). %BF and height were used to calculate fat mass index (FMI; kg/m^2).

Defining overweight and obesity

Adolescents were classified into three groups as follows: (i) normal-weight normal-fat (BMI for age and sex <25 kg/m^2; FMI<4.58 kg/m2 in boys, FMI<7.76 kg/m^2 in girls); (ii) normal-weight overfat (BMI for age and sex <25 kg/m^2; FMI≥4.58 kg/m2 in boys, FMI≥7.76 kg/m^2 in girls); (iii) overweight normal-fat (BMI for age and sex <25-BMI-<30 kg/m^2; FMI<4.58 kg/m^2 in boys, FMI<7.76 kg/m^2 in girls); (iv) overweight overfat (BMI for age and sex <25-BMI-<30 kg/m^2; FMI≥4.58 kg/m^2 in boys, FMI≥7.76 kg/m^2 in girls); and (v) obesity (BMI for age and sex ≥30 kg/m^2). Age- and sex-specific BMI cut-offs were used according to the International Obesity Task Force and Cole et al. [10] definitions, and FMI cut-offs according to Alvero-Cruz et al. [12] criteria for adolescents: 4.58 kg/m^2 in boys and 7.76 kg/m^2 in girls, as the limit between normal-fat and overfat.

Body image

Perceived body image was measured using the Stunkard scale [13], which consists of silhouette drawings ranging from 1 to 9 with monotonic increments in overweight percentage where 1 is the leanest and 9 is the heaviest. Separate figures for boys and girls were used. Participants were asked to identify of the 9 body figures: (a) ‘Which silhouette looks most like yourself?’ and (b) ‘Which silhouette would you like to look like?’ The difference between perceived body image and desired body image was used to determine the level of dissatisfaction with current body image. Values other than zero represent dissatisfaction with perceived body image. A positive value was indicative of the participant’s desire to be thinner than his/her perceived current size, while a negative value reflected the participant’s desire to be thicker than his/her current perceived size [14,15]. Other questions such as to be worried about weight gain (no; a little; a lot) and encourage to lose weight (yes; no) were also considered.

Statistics

Analyses were performed with Statistical Package for the Social Sciences version 19.0 (SPSS, Inc., Chicago, IL, USA). All tests were stratified by sex. Significant differences in prevalence were calculated by means of χ^2. The level of significance was established for *P* values <0.05.

Results

Table 1 shows the prevalence of normal-weight, overweight and obesity (BMI) according to overall adiposity (FMI) and period of study. Thus, the three body weight groups obtained by IOTF cut-offs (normal-weight, overweight and obesity) were subgrouped according to presence or absence of overfat. Adolescents were classified into five groups as following: 73.2% normal-weight normal-fat, 2.1% normal-weight overfat, 6.7% overweight normal-fat, 11.9 % overweight overfat and 6.1% obesity in 2007-2008. Overweight overfat and obesity estimates of 2-academic years later were 12.5% and 5.7%, respectively (P>0.05); although overweight overfat prevalence significantly increased from 7.1% to 10.9% among girls (P<0.05).

Overall, in 2007-08 more than a half of boys and girls were more likely to desire a silhouette 4 and 3 as ideal, respectively; while there was no majority elected ideal silhouette 2-academic years later, with boys more likely to choose silhouettes 3 to 5 and girls silhouettes 3 and 4 (Figure 1).

Despite that about 22% of normal-weight normal-fat girls preferred to look as silhouette 2, results indicated an increase from 20.9% to 33.1% for desire to look as silhouette 4 in them, at the expense of decreased desire to look as silhouette 3 (from 56.1% to 42.2%) (Figure 2). Parallel to this result, 2-academic years later normal-weight normal-fat girls were also less worried about weight gain (from 61.7% to 50.2%) (Figure 3) and increase percentage of those who reported to have not ever attempted to lose weight (from 41.9% to 50.6%).

Among boys, differences in desire to look as silhouette 3 to 5 were found among the non-overweight groups (Figures 4-6). No differences in preoccupation about weight gain and having ever tried to lose weight were found among boys.

Discussion

In 2007-2008, an estimated 11.9% and 6.1% of adolescents were overweight overfat and obese, respectively. Estimates of 2-academic years later were 12.5% and 5.7%, respectively ($P>0.05$); although overweight overfat prevalence significantly increased from 7.1% to 10.9% among girls ($P<0.05$).

Body image is a multidimensional construct central to emotional well-being [16,17] that involves subjective evaluations of one's body [18]. The attitudinal component of body image is satisfaction with body size [16,17], a factor associated with self-esteem. Despite that overweight and obesity prevalence have increased dramatically worldwide among children and adolescents in recent times [19,20], recently studies have suggested that body dissatisfaction caused by excessive weight may be decreasing among young people [6].

Despite that about 22% of normal-weight normal-fat girls preferred to look as silhouette 2, results indicated an increase from 20.9% to 33.1% for desire for a silhouette 4 in them (decreasing desire to look as silhouette 3). Parallel to this result, normal-weight normal-fat girls were also less worried about weight gain and increased percentage of those who reported to have not ever attempted to lose weight. Although more studies should be done, the present results suggest an increase in the acceptance of a slightly higher figure in normal-weight girls –but remaining in the thinness patterns- that could be related to the overweight prevalence increased.

Boys also suffer body image disturbances [5] and although more studies should be done, changes in body shape preferences could be also emerging among them. In the present study, the greatest interest to look as silhouettes 3 and 5 occurred among the non-overweight groups. In the literature it has been extensively reported that the current ideal male body is lean but highly muscular, characterised by a "well-developed chest and arms, with wide shoulders tapering down to a narrow waist" [21]. The greatest interest for look as silhouette 5 observed in normal-weight boys may be related to a higher desire to increase own body weight and muscle mass [22-24]; whereas in obese boys could be associated with an increase in the acceptance of a slightly higher figure but remaining in the healthy pattern. On the other hand, despite that boys with elevated adiposity have been more likely to have negative feelings about their bodies [25]; the present results indicated that in boys should be emerging an acceptance of certain levels of adiposity. However, it should be noted that the Stunkard's standard silhouettes [13] do not distinguish between increased sizes due to muscle and increased size due to fat and more studies should be done.

Certainly, boys and girls perceive their bodies in a different way [26]: while boys with lower BMI and body fat preferred a stronger muscular body, girls showed a preference for a slim body shape [24,26]. However, the greatest interest to look as silhouette 3 in both normal-weight groups and in the obesity group observed in boys could be indicating an emerging interest for a slim body shape in them.

It should be noted that any reduction of 'feeling fat' among adolescents in the healthy weight range is a welcome finding [27], but if this is parallel by reductions in recognition of body fatness in the overweight and obesity population, it may create new problems. In fact, some researches have argued that some level of body dissatisfaction may be beneficial for individuals with average or above-average weight, as it may lead to healthy weight management behaviours such as increased intake of fruits and vegetables and regular physical activity [28-30].

Limitations of the study

Body fat was calculated using Slaughter et al. equations [8] which have been suggested previously by Rodríguez et al. [9]. However, the present study did not take into account pubertal development despite that chronological age may vary dramatically during this phase. Therefore, as in a previous study [31] in which adolescents have been classified according to their pubertal stage, boys were divided into two groups: pubertal (12 to 14 years old) and post-pubertal (15 to 17 years old).

Conclusion

In sum, changes in body shape preferences could be emerging among the adolescent population. While normal-weight girls may be accepting a slightly higher body shape; a desire for a slim body shape may be increasing among boys. However, further studies are needed to confirm changes in body image in adolescents.

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Authors' contributions

MMB, JP and JAT conceived, designed, devised and supervised the study, MMB, JP and JAT collected and supervised the samples. MMB and JAT analysed the data and wrote the manuscript. AP and JAT obtained funding. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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Table 1. Prevalence (%) of overweight and obesity according to body weight (BMI) and FMI among Balearic Islands' adolescents (2007-2009)

	Total			Boys			Girls		
	2007-08 (*n*=1231)	**2009 (*n*=730)**	***P***	**2007-08 (*n*=574)**	**2009 (*n*=365)**	***P***	**2007-08 (*n*=657)**	**2009 (*n*=365)**	***P***
Normal-weight	75.3	73.5	NS	72.3	72.5	NS	77.8	74.6	NS
Normal-fat	73.2	70.1	NS	68.3	66.3	NS	77.4	74.0	NS
Overfat	2.1	3.4	NS	4.0	6.2	NS	0.5	0.6	NS
Overweight									
Normal-fat	6.7	8.3	NS	3.6	5.7	NS	9.3	10.9	NS
Overfat	11.9	12.5	NS	17.6	14.2	NS	7.1	10.9	*
Obesity	6.1	5.7	NS	6.5	7.6	NS	5.8	3.7	NS

Abbreviators: BMI, body mass index; FMI, fat mass index.
Significant differences between surveys by χ^2 (**P*<0.05). NS: not significant.

FIGURES

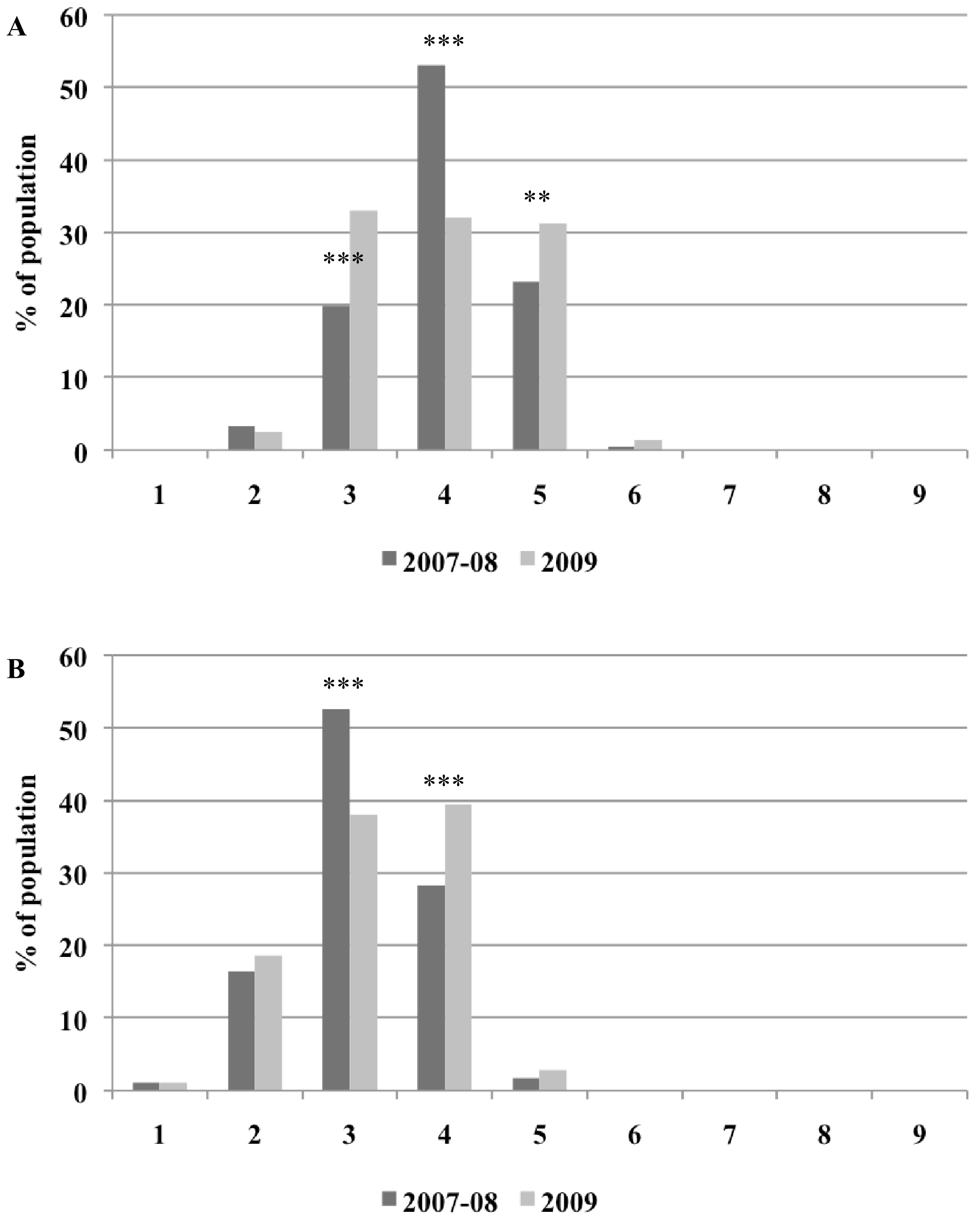

Figure 1. Percentage of boys (A) and girls (B) by ideal silhouette. Significant differences between surveys by χ^2 (*P<0.05, ** P<0.01, *** P<0.001).

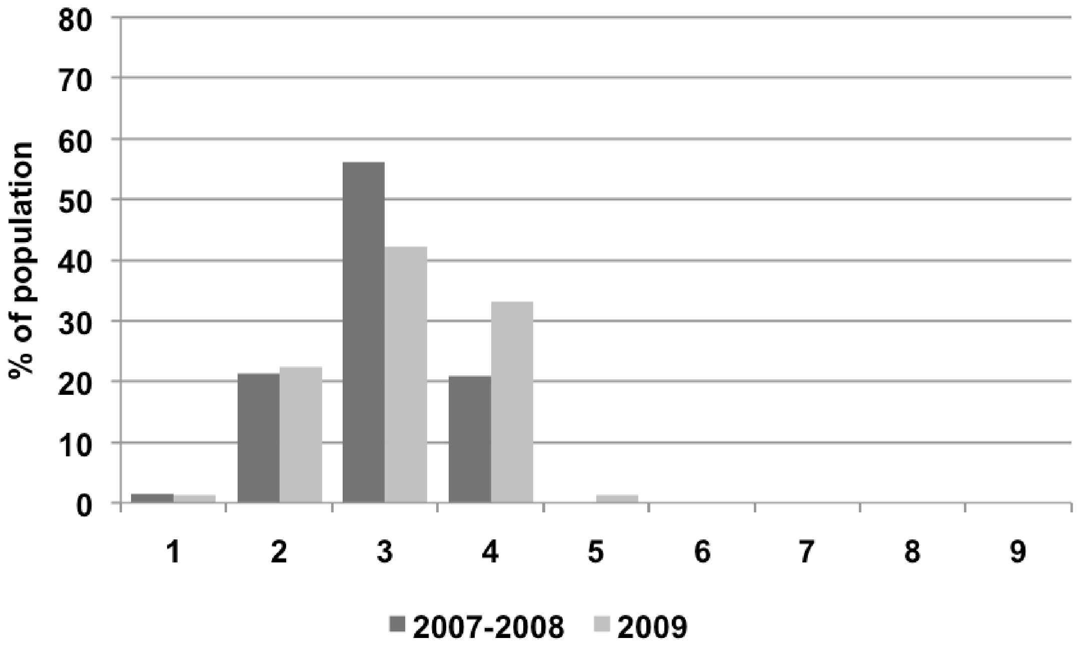

Figure 2. Desire silhouette to look (%) among normal-weight normal-fat girls.

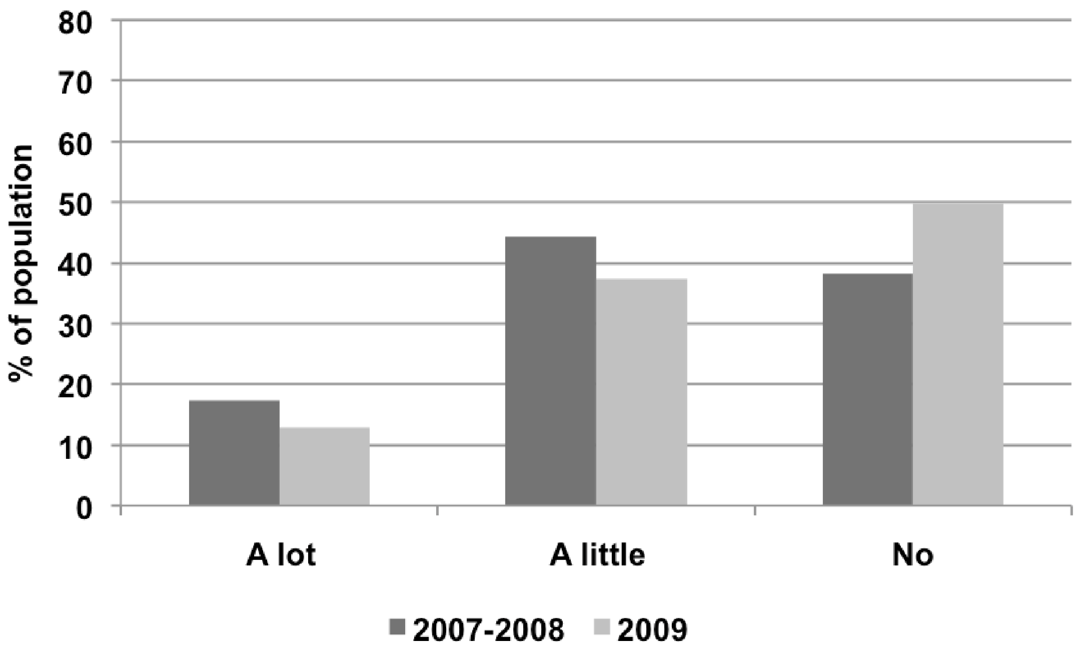

Figure 3. Prevalence (%) of preoccupation about weight gain among normal-weight normal-fat girls.

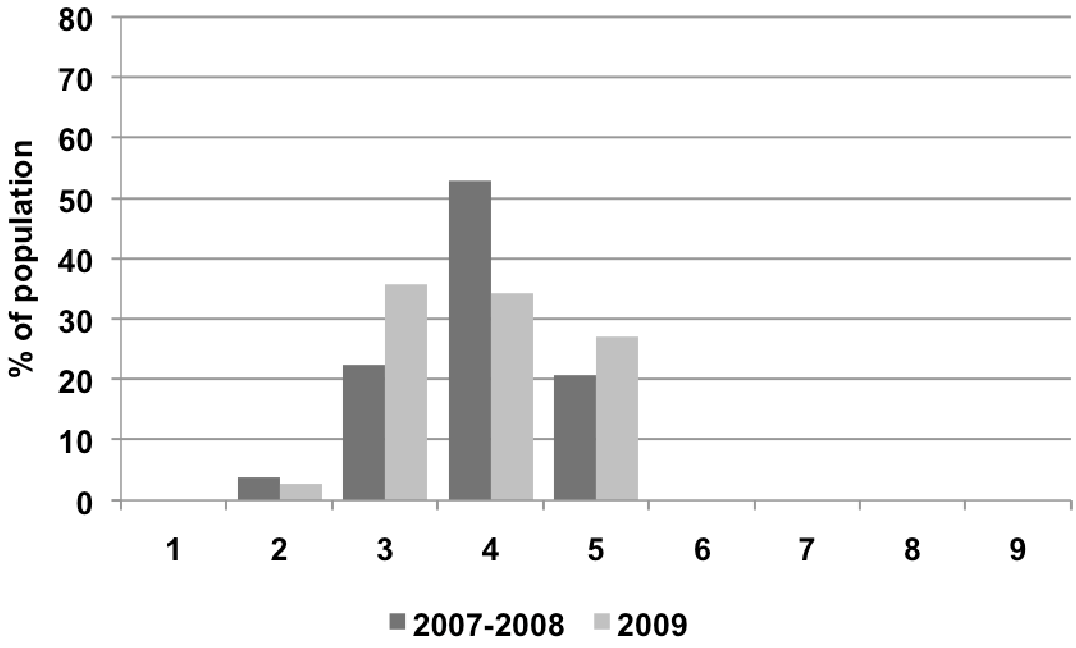

Figure 4. Desire silhouette to look (%) among normal-weight normal-fat boys.

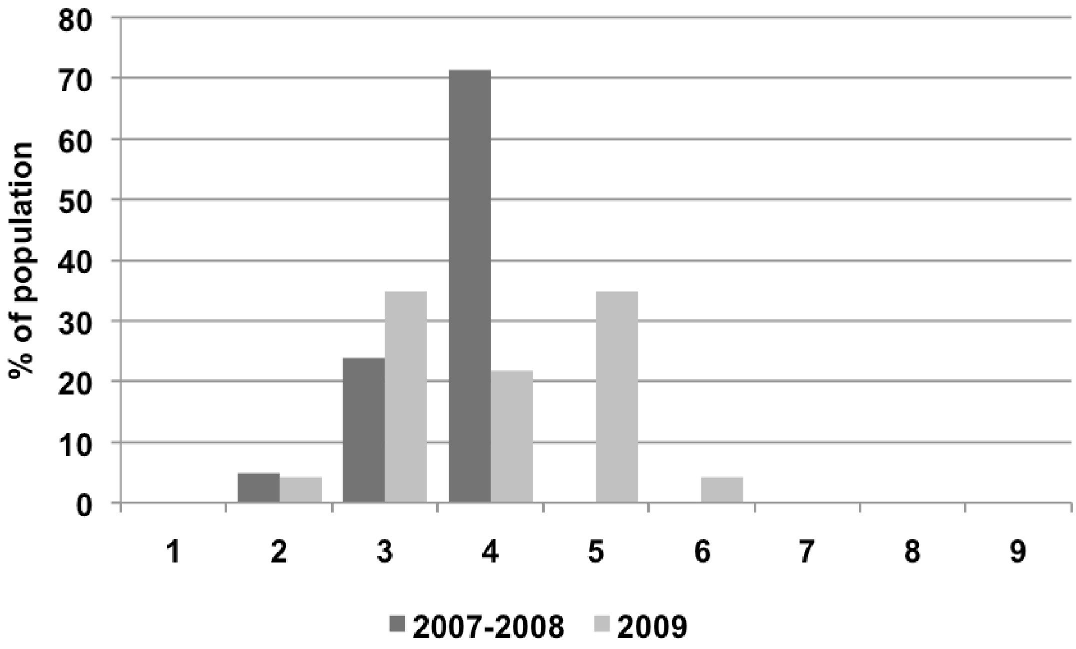

Figure 5. Desire silhouette to look (%) among normal-weight overfat boys.

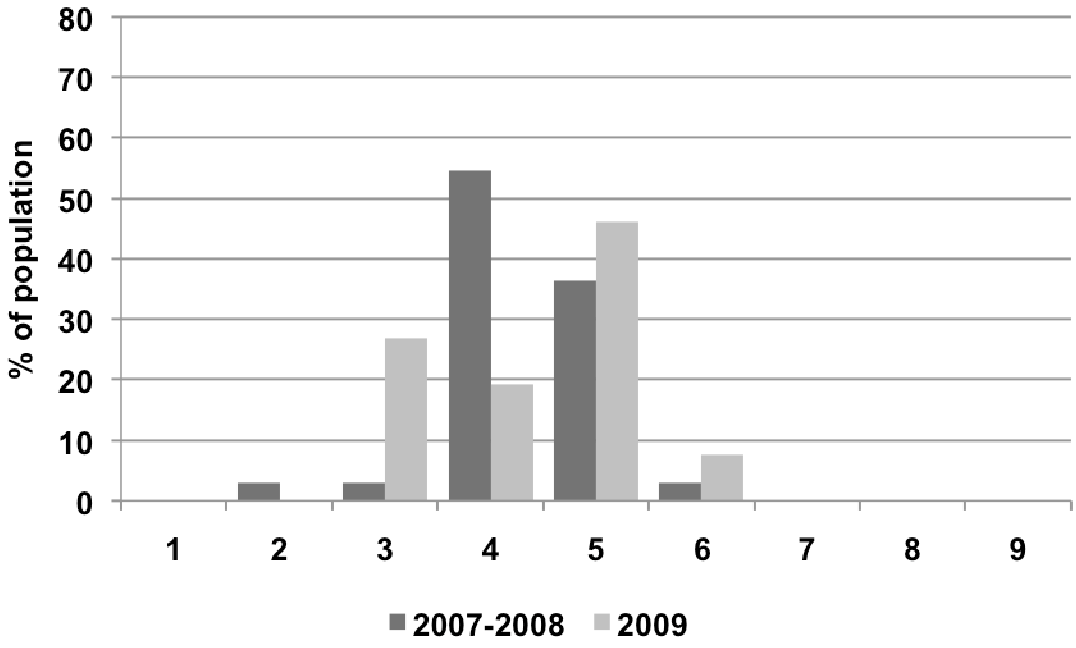

Figure 6. Desire silhouette to look (%) among obese boys.

Manuscrit XI

Prevalence of overweight and obesity in adolescents: a systematic review.

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Prevalence of overweight and obesity in adolescents: a systematic review.

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Abstract

The objective of this study was to review extant literature on the prevalence of overweight and obesity in adolescents (10-19 years old) of both sexes. The search was carried out using Medline considering articles published from the establishment of the databanks until 13 September 2011. We also reviewed the data on the prevalence of children being overweight and obesity from the International Obesity Task Force (IOTF) Website. Only original articles and one National Health Report were considered. Thirty-eight studies met the inclusion criteria. Twenty-three of these studies were nationally representative and eleven countries were represented only by regional data. According to national data, the prevalence of overweight and obesity is high, especially in many parts of the world. Although it is not clear which sex has a higher proportion of adolescents with overweight; obesity are higher among boys. Finally, despite there is no consensus about criteria to be used for classifying overweight and obesity in adolescents, the IOTF is the most frequently used classification for adolescent overweight and obesity in public health research.

Keywords: Adolescents, cross-sectional study, systematic review, overweight, obesity

Introduction

In recent times, the prevalence of overweight and obesity among children and adolescents has increased dramatically worldwide [1,2], making it one of the most common chronic disorders in this age group and in adulthood.

The use of body mass index (BMI) for age to define being overweight and obesity in children and adolescents is well established for both clinical and public health applications, because of their feasibility under clinical settings and in epidemiological studies [3,4]. In children and adolescents, the natural increases in BMI that occur with age necessitate the use of age-sex-specific thresholds. The most widely growth charts used are the Centers for Disease Control and Prevention (CDC-2000) [5], the International Task Force (IOTF) [6] and the 2007 growth references for 5 to 19 year-olds produced by the World Health Organization (WHO-2007) [7].

The CDC-2000 growth charts were developed to evaluate the nutritional status of US children, and were originated from five cross-sectional representative surveys carried out in the US between 1963 and 1994. This growth charts are routinely applied to identify children and adolescents with a BMI greater than the 85th or 95th percentiles following the advice of the US Expert Committee on Childhood Obesity [8]. However, the appropriateness of an American dataset for defining overweight in young people from other countries is questionable [9].

The IOTF reference also uses age-sex-specific BMI percentiles and overweight and obesity definition correspond to an adult BMI of 25 and 30 kg/m^2, respectively, and reflect values in children tracking to overweight and obesity in adults [6]. This reference is based on six large international cross-sectional representative datasets, identifying the BMI values that extrapolate to childhood.

The WHO-2007 growth references were created to replace the National Center for Health Statistics (NCHS) references [10,11]. This reference was construct using data from the 1977 NCHS/WHO growth reference (1 to 24 years old) merged with data from the 2006 WHO Child Growth Standards for preschool children (under 5 years of age) using state-of-the-art statistical methods [7].

No systematic review has been conducted to understand the worldwide magnitude of the overweight and obesity problem among the adolescent population. Thus, the objective of this study was to systematically review the literature regarding the prevalence of overweight and obesity in adolescents (10-19 years old) of both sexes published in the past 12 academic years (1999-2011).

Methods

A systematic literature search was performed which ended on 13 September 2011. The literature search was conducted in Medline using the following MeSH-terms: ‘overweight’; ‘obesity’; ‘prevalence’; ‘adolescent’. In total, 2307 articles were selected. We also reviewed the data on the prevalence of childhood overweight and obesity on the International Obesity Task Force Website at http://www.iaso.org/iotf/. To find the articles included in this review, the following inclusion criteria were used: (1) cross-sectional studies conducted in the last 12 academic years (1999-2011) –when the original study did not report the survey year was not included-; (2) national and regional representative samples, and articles published on the prevalence of overweight in towns, urban or rural area in the country were excluded from the prevalence tables; (3) weight and height objectively measured; (4) results presented by sex; (5) and for both overweight and obesity prevalence; (6) the definition of overweight and obesity using the (i) CDC-2000 [5], (ii) IOTF [6], and (iii) WHO-2007 [7] growth references; and (7) studies written in English, Spanish, Italian or Portuguese. Moreover, if there were more than one national or regional study in the same country, the recent one was included in the prevalence tables. The total numbers of articles included in this review, therefore, were about 37 articles related to overweight and obesity. We also undertook a study to look at the latest statistics on the prevalence of overweight and obesity in South Africa [12].

Potentially relevant papers were selected by (1) screening the titles; (2) screening the abstracts and (3) if abstracts were not available or did not provide sufficient data, the entire article was retrieved and screened to determine whether it met the inclusion criteria

Results

Literature search

A total of 37 articles and a National Health Report were eligible according to the inclusion criteria established for this review. Table 1 presents a description of the 38 studies selected for this review including the continent and the country were it was performed (and region for not national studies), year of publishing, total number of participants in the study, number of adolescents, age range, proportion of girls, and number and definition for overweight and obesity classification used. All the articles were published after the year of 2002. 12 articles included children (up to 10 years old) [13-24]. While nationally representative data were obtained in 24 countries (including Northern Ireland); 11 countries were represented only by regional data [25-35].

Prevalence and criteria for classification

Table 2 presents overweight and obesity prevalence from the 23 national studies (one of them including data from Northern Ireland) that were included in this review according to the continent and the country were it was performed, year of survey, study population, age range, criteria used for classifying overweight and obesity used, and along with total data by sex. There were 30 different prevalence levels described in the included articles, because 5 countries presented data using at least two different criteria for overweight and obesity classification [14,17,18,36,37]. The IOTF cut-off was used to classify overweight and obesity in 21 of the 23 national studies considered in the present review.

There was a broad range of overweight and obesity prevalence noted. In general, the prevalence of overweight plus obesity was higher in America, Oceania and Europe and lower in Africa and certain parts of Asia (in two of the Asian countries the total prevalence was less than 10% by the IOTF cut-offs) [16,17,38]. Overall, about 30% of American adolescents and 22-25% of European adolescents (excepting the Czech Republic and Italian adolescents' which showed a prevalence of 13.7% and 17.9%, respectively) were overweight or obese. Among Oceanian adolescents the prevalence ranged from 23.2% in Australia in 2004 to 34.2% in New Zealand in 2007. In Africa, the overall prevalence of overweight and obesity was lower than 20%. Among Asian adolescents there was a broad range of overweight plus obesity. Using IOTF cut-off, the prevalence of being overweight or obese for Asian boys and girls ranged from 5.2% in China in 2002 to 36.4% in Bahrain in 2000.

Table 3 shows regional data prevalence of overweight and obesity from 15 countries. Specific prevalence from all the geographic regions was included in this review from 3 countries: South Africa (9 provinces), USA (52 states) and Italy (5 regions). In Europe, data from islands of Greece (Crete) and Italy (Sicily and Sardinia) and Spain (Balearic Islands, which is an archipelago; and the Grand Canary Island) were also included. On the other hand, regional but not national data was found for 11 countries (Brazil, Jordan, India, France, Italy, Poland, Switzerland, Spain, Turkey, Denmark and Hungary). The IOTF cut-off was used to classify overweight and obesity in 14 of the 18 selected studies that included regional data. In one study data was presented using only the WHO-2007 growth charts [32] and in two studies using only the CDC-2000 growth reference [27,39].

In South Africa and USA, substantial geographic variations in adolescent overweight and obesity existed. In 2008, overweight and obesity prevalence varied in South Africa from a low of 13.5% for adolescents in Limpopo to a high of 25.5% in KwaZulu-Natal. In 2007, overweight and obesity varied in USA from 23.1% in Utah and Minnesota to a high of 44.5% in Mississippi. In 2002, the prevalence of overweight and obesity in the south of Italy and in Italian islands was higher among boys. In the south of Italy, the overweight prevalence among girls also was higher than in the other geographic regions.

Comparison between the islands from Greece (Crete), Italy (Sicily and Sardinia) and Spain (Balearic Islands and Grand Canary Island) which were included in this review showed that Crete had the higher prevalence of overweight and obesity –despite data were presented using different definition-. In Spain, using the IOTF cut-off (data not shown for Balearic Islands but proportioned by authors), the prevalence of overweight plus obesity was higher in the Grand Canary Island (29.1%) than in the Balearic Islands (24.7%).

Gender differences

According to national data, the prevalence of overweight was more than 10% higher for boys in 9 countries [14,19-22,24,40,42] and more than 10% for girls in 7 of the 24 countries (including Northern Ireland) [12,13,15,18,43-45]. The obesity prevalence was more than 10% higher for boys in 17 countries [14,16-22,24,36,37,39,40-42,45,46] and more than 10% for girls in 4 of the 23 countries (including Northern Ireland) [12,13,43,44].

Discussion

The objective of this study was to review the literature on overweight and obesity prevalence among adolescents. Thirty-seven articles and one National Health Report that met the inclusion criteria were included in this review. The overweight and obesity prevalence in the included studies ranged widely. In 14 of the 21 countries with national representative data using the IOTF cut-off, values higher than 20% were found, with 4 countries showing prevalence above 30% and in only 2 countries values were lower than 10%.

Regarding national data, when prevalence was analysed according to the sex, it was observed that in almost half of the countries boys presented a higher proportion of overweight, as well as a higher proportion of obesity in almost four to five countries. This result is consistent with other epidemiological review investigating prevalence of abdominal obesity in adolescents; where in almost half of the studies boys also presented a higher proportion [47]. Differences of prevalence among sexes might have been being related to geopolitical and cultural conditions of evaluated countries [47].

Nine national studies included in this review presented results over subsequent years [13,15,16,19,22,24,31,39,45]. Eight articles compared data between 1980s and/or 1990s with 2000s [13,15,16,19,22,24,39,45], indicating an increasing prevalence of overweight and obesity in both sex over this period [13,15,1619,22,31,45], except among Australian adolescents, in which the overweight and obesity prevalence combined increased significantly among boys but not among girls over the period 1997 to 2004 [24]. In USA, overweight and obesity prevalence also increased by 4% and 10% for all adolescents between 2003 and 2007, respectively. Overweight and obesity prevalence increased by 3% and 18% for all USA girls over this period. Contrarily, since 2004 the overweight and obesity trend was stabilized or turned into a downward trend among German adolescents [22].

In USA, substantial geographic disparities in adolescent overweight and obesity were found, with an apparent shift toward higher prevalence in 2007 for several states [39]. Generally, overweight and obesity prevalence was also higher in southern USA in 2007. Lobstein et al [48] have reported that generally children in northern Europe countries tend to have lower overweight and obesity prevalence (10-20%) than in southern Europe (20-35%). But also within the same country, the prevalence and trend of overweight and obesity may not be homogeneous in view of different geographic regions [49]. In Italy, a north-south gradient in overweight and obesity prevalence among adolescent boys but also in overweight prevalence among Italian girls was also reported [42]. In Spain, a higher prevalence of overweight and obesity has been reported in southern in both children [50] and adults [51].

It is important to note that the choice of a reference and a cut-off point will determine the absolute prevalence of overweight and obesity and its trend [52]. The most frequently used classification for adolescent overweight and obesity is the IOTF [6]. Cole et al [6] argue that the reference they published, supported by the IOTF, is less arbitrary and more international than others and recommended its use in international comparisons. Recently, Monasta et al [53] has also suggested that the IOTF reference and cut-offs could be preferable for the identification of overweight and obesity both at individual and population levels because they are at least based on a crude association with ill health later in life, namely the definition of overweight and obesity at age 18 years [53]. However, the IOTF cut-offs have been not recommended for clinical use when assessing an individual child’s growth [54-56]. Furthermore, the recent findings suggest that a universal BMI classification system for childhood and adolescent overweight and obesity may not correspond to a comparable level of body fatness in all populations [57]. The prevalence estimates may not accurately characterize the population groups most at risk of health disadvantages because the correlation of BMI with adiposity is highly variable and dependent on ethnic group [52,57-59].

Limitations of the study

It is important to note the limitations in our review. Firstly, the comparisons of overweight and obesity prevalence need interpretation with caution due to the difference in survey sampling methods, sample sizes, age range of subjects, quality of data in terms of height and weight measurement and whether national programmes or strategies to tackle overweight and obesity are in place [49]. Even within the same country, the prevalence and trend of overweight and obesity may not be homogenous in view of different ethnicities, geographic regions and socioeconomic status [49]. Furthermore, although we did not limit our search by English, only articles in English, Spanish, Italian and Portuguese were included in this review.

Conclusion

The results of this review allow the following conclusions: (1) overweight and obesity prevalence is high, especially in many parts of the world; (2) obesity are higher among boys, although it is not clear which sex has a higher proportion of adolescents with overweight; (3) despite there is no consensus about criteria to be used for classifying overweight and obesity in adolescents, the most frequently used was the IOTF reference [6]. However, the international reference charts for monitoring the secular trends in childhood obesity need to be continually refined and evaluated [48]. Finally, the results of this study would contribute to guiding health planners and administrators to develop proper tools for adolescent obesity management.

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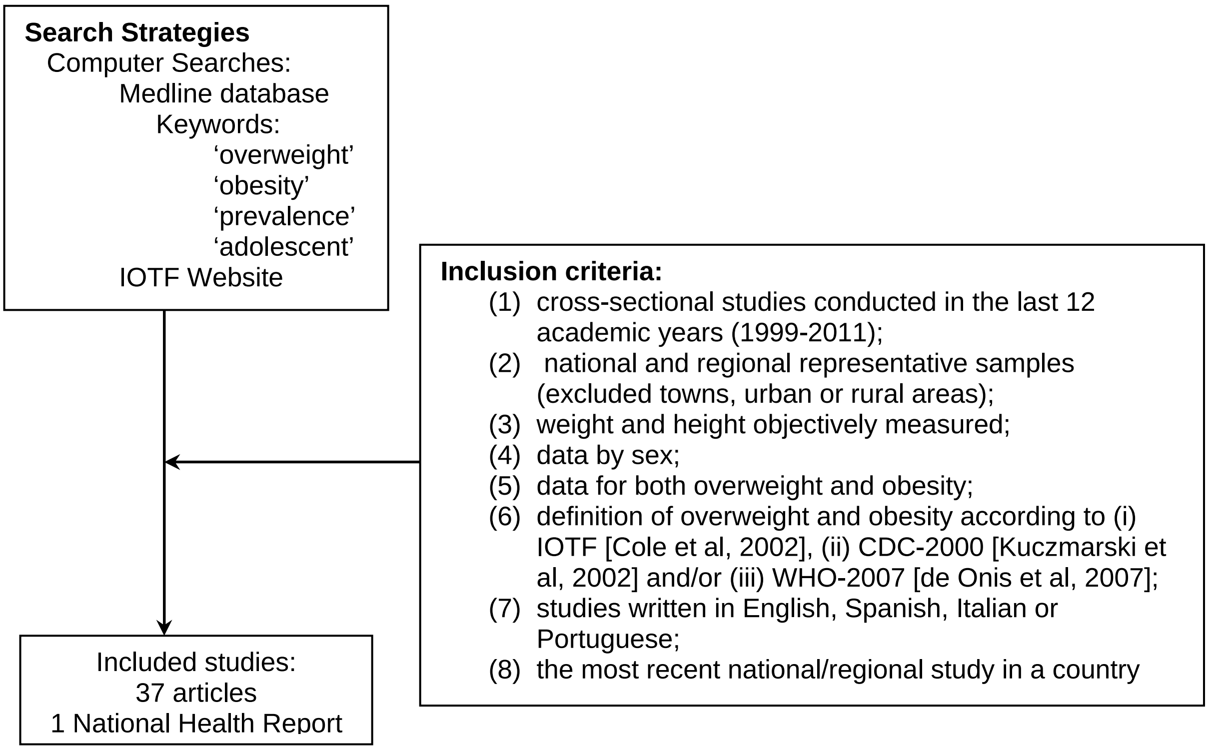

Figure 1. Flow diagram of study selection

Table 1. Descriptive analysis of the studies reviewed

Area	*Continent*	*Country, Region*	*Date of survey*	*n total of study*[1]	*n total of adolescents*[1]	*Age (years)/ School grade*	*Proportion of girls*	*Number of definition*	*Definition*	*Ref.*
National	AFRICA	Seychelles	2004	4,854	2,177	7^{th},10^{th}	51.5%	1	IOTF	[13]
		South Africa	2008	9,862	9,862	13-19	50.9%	1	IOTF	[12]
		Tunisia	2004	2,872	2,872	15-19	54.9%	1	IOTF	[43]
	AMERICA	Canada	2004	8,661	4,099	12-17	-	3	IOTF, CDC, WHO	[14]
		Mexico	2006	48,304	13,219	12-18	50.7%	1	IOTF	[15]
		USA	2007	44,101	44,101	10-17	-	1	CDC	[39]
	ASIA	Bahrain	2000	506	506	12-17	50.8%	1	IOTF	[44]
		China	2002	44,880	12,475	13-17	47.7%	1	IOTF	[16]
		Iran	2003-04	21,111	16,035	10-18	51.3%	2	IOTF, CDC	[17]
		Israel	2003-04	5,588	5,588	11-19	55.1%	1	CDC	[46]
		Qatar	2003-04	3,923	3,923	12-17	49.8%	1	IOTF	[40]
		Saudi Arabia	2005	19,317	7,251	13-18	49.2%	2	CDC, WHO	[18]
		Taiwan	2003	72,789	58,424	10-18	49.0%	1	IOTF	[19]
	EUROPE	Cyprus	1999-2000	2,467	1,694	10-17	50.7%	1	IOTF	[20]
		Czech Republic	2005	1,417	957	11-17	49.4%	1	IOTF	[21]
		Germany	2008	40,622	5,623	12-16	46.7%	1	IOTF	[22]
		Greece	2003	14,456	14,456	13-19	53.8%	1	IOTF	[41]
		Italy	2002	4,386	4,386	11,13,15	51.6%	1	IOTF	[42]
		Republic of Ireland	2003	17,499	7,294	11-16	50.6%	1	IOTF	[23]
		Northern Ireland	2003	2,039	964	11-15	51.5%	1	IOTF	[23]
		Portugal	2008	22,048	22,048	10-18	51.5%	2	IOTF, WHO	[36]
		Sweden	2001	1,732	1,732	10,13,16	48.3%	1	IOTF	[45]
	OCEANIA	Australia	2004	5,407	1,771	8^{th},10^{th}	45.6%	1	IOTF	[24]
		New Zealand	2007	8,796	8,796	13-17	45.4%	2	IOTF, WHO	[37]
Regional	AFRICA	South Africa, Eastern Cape	2008	926	926	13-19	52.1%	1	IOTF	[12]
		South Africa, Free State	2008	1,236	1,236	13-19	49.1%	1	IOTF	[12]
		South Africa, Gauteng	2008	931	931	13-19	52.1%	1	IOTF	[12]
		South Africa, KwaZulu-Natal	2008	910	910	13-19	52.1%	1	IOTF	[12]
		South Africa, Limpopo	2008	1,140	1,140	13-19	50.5%	1	IOTF	[12]
		South Africa, Mpumalanga	2008	1,238	1,238	13-19	49.8%	1	IOTF	[12]
		South Africa, Northern Cape	2008	1,088	1,088	13-19	48.6%	1	IOTF	[12]
		South Africa, North West	2008	1,234	1,234	13-19	48.6%	1	IOTF	[12]

Table 1. *Continued*

Area	*Continent*	*Country, Region*	*Date of survey*	*n total of study*[1]	*n total of adolescents*[1]	*Age (years)/ School grade*	*Proportion of girls*	*Number of definition*	*Definition*	*Ref.*
		South Africa, Western Cape	2008	1,159	1,159	13-19	56.4%	1	IOTF	[12]
	AMERICA	USA, 52 Sates[2]	2007	-	-	10-17	-	1	CDC	[39]
		Brazil, Pernambuco State	2006	4,210	4,210	14-19	59.8%	1	IOTF	[25]
	ASIA	China, Hong Kong	2003-04	2,098	2,098	11-18	53.2%	2	IOTF, CDC	[38]
		India, Manipur	2005-06	3,356	3,356	12-19	56.2%	1	IOTF	[26]
		Jordan, Irbid Governorate	2007	1,355	1,355	13-16	55.6%	1	CDC	[27]
	EUROPE	Denmark, Greater Copenhagen area and 3 municipalities outside the Capital Region	2007-09	7,541	7,541	14-16	50.1%	1	IOTF	[28]
		France, Aquitane Region	2004-05	2,385	2,385	11-18	49.1%	1	IOTF	[29]
		Greece, Crete	2005-06	481	481	10-12	54.0%	1	IOTF	[60]
		Hungary, Szeged and Szolnok regions	2005-2006	14,290	14,290	11-16	48.1%	1	IOTF	[30]
		Italy, 5 residence regions[3]	2002	4,386	4,386	11-15	51.6%	1	IOTF	[42]
		Italy, Sardinia	1999-2001	3,946	3,946	11-15	49.0%	1	IOTF	[61]
		Italy, Sicily	1999-2001	48,897	48,897	11-15	50.7%	1	CDC	[62]
		Poland, Kujawsko-Pomorskie	2005	-	-	13-15	-	1	IOTF	[31]
		Poland, Lubuskie	2005	-	-	13-15	-	1	IOTF	[31]
		Poland, Malapolskie	2005	-	-	13-15	-	1	IOTF	[31]
		Poland, Podlaskie	2005	-	-	13-15	-	1	IOTF	[31]
		Poland, Pomorskie	2005	-	-	13-15	-	1	IOTF	[31]
		Spain, Balearic Islands	2007-08	1,231	1,231	12-17	53.4%	1	WHO	[32]
		Spain, Grand Canary	2004-05	1,002	1,002	12-14	50.0%	1	IOTF	[33]
		Switzerland, Canton of Vaud	2005-06	5,207	5,207	10-14	49.7%	2	IOTF, CDC	[34]
		Turkey, Edirne Province	2001	989	989	12-17	48.1%	1	IOTF	[35]

Abbreviations: Ref., reference; IOTF, International Obesity Task Force; CDC, Center for Disease Control and Prevention; WHO, World Health Organization.

[1]Only subjects with anthropometric measurements were included in each state.

[2]There are 52 States in the USA, but not information about total number of subjects was included in each state.

[3]Vieno et al [42] assessed the overall overweight and obesity prevalence among Italian adolescents, and also according to the geographic region: North-West, North-East, Center, South and Islands, but not information about total number of subjects was included in each region.

Table 2. Description of overweight and obesity prevalence (%) along with total data by sex from each national study that was included in the review according to year of survey, study population, age range and classification criteria used

Continent	Country	Date of survey	Study population	Age (years)/ School grade	Criteria	Overweight (%)			Obesity (%)			Ref.
						All	Boys	Girls	All	Boys	Girls	
AFRICA	Seychelles	2004	School-based survey	7^{th},10^{th}	IOTF[1]	12.0	9.5	14.3	5.1	4.2	6.0	[13]
	South Africa	2008	2008 SA YRBS	13-19	IOTF[1]	14.4	7.9	20.6	5.3	3.3	7.2	[12]
	Tunisia	2004	Household-based survey	15-19	IOTF[1]	12.4	11.0	14.1	2.6	1.9	3.2	[43]
AMERICA	Canada	2004	2004 CCHS	12-17	IOTF[1]	19.8	21.2	18.4	9.4	11.1	7.4	[14]
					CDC-2000[2]	15.9	17.0	14.7	12.1	14.3	9.6	
					WHO-2007[3]	20.8	21.9	19.6	12.4	15.1	9.4	
	Mexico	2006	Household-based survey	12-18	IOTF[1]	21.2	20.1	22.3	8.9	9.2	8.6	[15]
	USA	2007	2007 NSCH	10-17	CDC-2000[2]	15.2	15.3	15.2	16.4	19.2	13.5	[39]
ASIA	Bahrain	2000	School-based survey	12-17	IOTF[1]	20.0	15.3	24.5	16.4	14.9	17.9	[44]
	China	2002	2002 CNNHS	13-17	IOTF[1]	4.6	4.6	4.6	0.6	0.7	0.5	[16]
	Iran	2003-2004	CASPIAN Study	10-18	IOTF[1]	5.9	5.7	6.0	1.3	1.5	1.1	[17]
					CDC-2000[2]	4.5	4.3	4.7	1.9	2.3	1.6	
	Israel	2003-2004	MABAT Youth Survey	11-19	CDC-2000[2]	12.9	12.7	13.0	5.6	7.4	4.1	[46]
	Qatar	2003-2004	School-based survey	12-17	IOTF[1]	23.8	28.6	18.9	6.3	7.9	4.7	[40]
	Saudi Arabia	2005	Household-based survey	13-18	CDC-2000[2]	17.9	16.5	19.6	7.0	8.2	5.5	[18]
					WHO-2007[3]	16.0	13.6	18.4	10.6	11.2	10.0	
	Taiwan	2003	School-based survey	10-18	IOTF[1]	16.3	18.4	14.2	6.2	8.1	4.2	[19]
EUROPE	Cyprus	1999-2000	School-based survey	10-17	IOTF[1]	18.9	21.3	16.5	5.8	7.1	4.5	[20]
	Czech Republic	2005	Lifestyle and Obesity Study	6-17	IOTF[1]	12.3	16.6	8.0	1.4	1.7	1.0	[21]
	Germany	2008	CrescNet database	12-16	IOTF[1]	18.2	19.3	17.0	6.2	7.6	4.6	[22]
	Greece	2003	School-based survey	13-19	IOTF[1]	18.3	23.3	14.0	4.3	6.1	2.7	[41]
	Italy	2002	HBSC Study	11,13,15	IOTF[1]	15.6	20.9	10.6	2.3	3.5	1.2	[42]
	Republic of Ireland	2003	School-based survey	11-16	IOTF[1]	18.5	17.8	19.2	5.8	5.6	6.1	[23]
	Northern Ireland	2003	School-based survey	11-15	IOTF[1]	18.2	18.5	17.8	5.9	6.0	5.7	[23]
	Portugal	2008	School-based survey	10-18	IOTF[1]	17.4	17.7	17.0	5.2	5.8	4.6	[36]
					WHO-2007	21.8	20.4	23.1	9.9	10.3	9.6	
	Sweden	2001	School-based survey	10,13,16	IOTF[1]	15.8	14.6	16.9	4.4	5.0	3.6	[45]
OCEANIA	Australia	2004	2004 SPANS	8^{th},10^{th}	IOTF[1]	17.9	19.4	16.2	5.3	6.7	3.6	[24]
	New Zealand	2007	Youth'07 Survey	13-17	IOTF[1]	24.0	23.3	24.7	10.2	10.8	9.5	[37]
					WHO-2007	25.9	25.9	26.0	13.5	14.6	12.1	

Table 2. *Continued*

Abbreviations: Ref., reference; IOTF, International Obesity Task Force; CDC, Center for Disease Control and Prevention; WHO, World Health Organization; 2008 SA YRBS, 2008 South African National Youth Risk Behaviour; 2004 CCHS, 2004 Canadian Community Health Survey; 2007 NSCH, National Survey of Children's Health; 2002 CNNHS, 2002 China National Nutrition and Health Survey; CASPIAN Study, Childhood and Adolescence Surveillance and Prevention of Adult Non-communicable disease; HBSC, Health Behaviour in School-aged Children; 2004 SPANS, 2004 NSW Schools Physical Activity and Nutrition Survey.
[1]Overweight and obesity, all adolescents with BMI-for-age ≥ 25 kg/m^2 and <30 kg/m^2 and ≥ 30 kg/m^2, respectively, according to the IOTF [Cole et al, 2002].
[2]Overweight and obesity, all adolescents with BMI-for-age $\geq$P85th and $<$P95th and $\geq$P95th, respectively, according to the CDC [Kuczmarski et al, 2002].
[3]Overweight and obesity, all adolescents with BMI-for-age $>+1$SD and $<+2$SD and $>+2$SD, respectively, according to the WHO [de Onis et al, 2007].

Table 3. Description of overweight and obesity prevalence (%) along with total data by sex from each regional study that was included in the review according to year of survey, study population, age range and classification criteria used

Continent	Country, Region	Date of survey	Study population	Age (years)	Criteria	Overweight (%)			Obesity (%)			Ref.
						All	Boys	Girls	All	Boys	Girls	
AFRICA	South Africa, Eastern Cape	2008	2008 SA YRBS	13-19	IOTF[1]	13.3	4.3	21.1	4.0	2.0	5.6	[12]
	South Africa, Free State	2008	2008 SA YRBS	13-19	IOTF[1]	11.6	8.1	15.1	4.7	3.7	5.7	[12]
	South Africa, Gauteng	2008	2008 SA YRBS	13-19	IOTF[1]	12.7	10.0	15.4	9.7	8.4	11.0	[12]
	South Africa, KwaZulu-Natal	2008	2008 SA YRBS	13-19	IOTF[1]	20.1	8.6	31.5	5.4	3.4	7.3	[12]
	South Africa, Limpopo	2008	2008 SA YRBS	13-19	IOTF[1]	10.7	6.2	15.1	2.8	1.0	4.5	[12]
	South Africa, Mpumalanga	2008	2008 SA YRBS	13-19	IOTF[1]	15.5	10.0	21.1	6.1	2.3	9.9	[12]
	South Africa, Northern Cape	2008	2008 SA YRBS	13-19	IOTF[1]	12.9	7.3	18.3	5.0	4.4	5.6	[12]
	South Africa, North West	2008	2008 SA YRBS	13-19	IOTF[1]	11.8	7.0	16.7	3.9	2.2	5.7	[12]
	South Africa, Western Cape	2008	2008 SA YRBS	13-19	IOTF[1]	14.3	9.7	18.5	5.6	2.0	8.9	[12]
AMERICA	USA, Alaska	2007	2007 NSCH	10-17	CDC-2000[2]	19.8	22.7	16.7	14.1	14.6	13.7	[39]
	USA, Alabama	2007	2007 NSCH	10-17	CDC-2000[2]	18.2	17.6	18.9	17.9	24.4	10.9	[39]
	USA, Arkansas	2007	2007 NSCH	10-17	CDC-2000[2]	17.1	15.0	19.2	20.4	27.2	13.2	[39]
	USA, Arizona	2007	2007 NSCH	10-17	CDC-2000[2]	12.8	12.7	12.7	17.8	20.6	15.0	[39]
	USA, California	2007	2007 NSCH	10-17	CDC-2000[2]	15.5	13.4	17.5	15.0	17.4	12.8	[39]
	USA, Colorado	2007	2007 NSCH	10-17	CDC-2000[2]	13.0	17.5	8.5	14.2	17.5	10.7	[39]
	USA, Connecticut	2007	2007 NSCH	10-17	CDC-2000[2]	13.2	14.7	11.7	12.5	14.8	10.2	[39]
	USA, Washington, DC	2007	2007 NSCH	10-17	CDC-2000[2]	15.2	11.6	18.7	20.2	22.2	18.2	[39]
	USA, Delaware	2007	2007 NSCH	10-17	CDC-2000[2]	19.9	22.0	17.8	13.3	12.2	14.4	[39]
	USA, Florida	2007	2007 NSCH	10-17	CDC-2000[2]	14.8	12.7	17.1	18.3	21.5	15.0	[39]
	USA, Georgia	2007	2007 NSCH	10-17	CDC-2000[2]	16.0	14.4	17.7	21.3	24.7	17.7	[39]
	USA, Hawaii	2007	2007 NSCH	10-17	CDC-2000[2]	17.3	17.5	17.1	11.2	15.0	7.1	[39]
	USA, Iowa	2007	2007 NSCH	10-17	CDC-2000[2]	15.3	14.8	15.9	11.2	11.3	11.0	[39]
	USA, Idaho	2007	2007 NSCH	10-17	CDC-2000[2]	15.7	14.4	17.2	11.8	16.4	6.8	[39]
	USA, Illinois	2007	2007 NSCH	10-17	CDC-2000[2]	14.2	12.1	16.4	20.7	25.0	16.3	[39]
	USA, Indiana	2007	2007 NSCH	10-17	CDC-2000[2]	15.2	11.5	19.3	14.7	17.4	11.7	[39]
	USA, Kansas	2007	2007 NSCH	10-17	CDC-2000[2]	14.9	16.0	13.7	16.2	16.2	16.3	[39]
	USA, Kentucky	2007	2007 NSCH	10-17	CDC-2000[2]	16.1	17.7	14.6	21.0	22.5	19.4	[39]
	USA, Louisiana	2007	2007 NSCH	10-17	CDC-2000[2]	15.2	15.5	14.9	20.7	23.1	18.1	[39]
	USA, Massachusetts	2007	2007 NSCH	10-17	CDC-2000[2]	16.7	18.2	15.4	13.3	16.1	10.5	[39]
	USA, Maryland	2007	2007 NSCH	10-17	CDC-2000[2]	15.2	19.1	11.1	13.6	17.0	9.9	[39]
	USA, Maine	2007	2007 NSCH	10-17	CDC-2000[2]	15.3	15.6	14.9	12.9	16.0	9.8	[39]
	USA, Michigan	2007	2007 NSCH	10-17	CDC-2000[2]	18.1	20.4	15.8	12.5	14.3	10.5	[39]

Table 3. *Continued*

Continent	*Country, Region*	*Date of survey*	*Study population*	*Age (years)*	*Criteria*	*Overweight (%)*			*Obesity (%)*			*Ref.*
						All	*Boys*	*Girls*	*All*	*Boys*	*Girls*	
	USA, Minnesota	2007	2007 NSCH	10-17	CDC-2000[2]	12.0	12.1	11.8	11.1	14.3	7.6	[39]
	USA, Missouri	2007	2007 NSCH	10-17	CDC-2000[2]	17.4	16.9	17.8	13.6	15.5	11.6	[39]
	USA, Mississippi	2007	2007 NSCH	10-17	CDC-2000[2]	22.6	21.6	23.5	21.9	25.5	18.5	[39]
	USA, Montana	2007	2007 NSCH	10-17	CDC-2000[2]	13.8	15.0	12.5	11.8	16.6	6.6	[39]
	USA, North Carolina	2007	2007 NSCH	10-17	CDC-2000[2]	14.9	13.9	16.0	18.6	19.3	17.9	[39]
	USA, North Dakota	2007	2007 NSCH	10-17	CDC-2000[2]	14.3	16.9	11.6	11.4	15.7	7.0	[39]
	USA, Nebraska	2007	2007 NSCH	10-17	CDC-2000[2]	15.7	13.9	17.5	15.8	23.0	8.1	[39]
	USA, New Hampshire	2007	2007 NSCH	10-17	CDC-2000[2]	16.6	17.1	16.2	12.8	16.3	8.8	[39]
	USA, New Jersey	2007	2007 NSCH	10-17	CDC-2000[2]	15.6	17.3	13.8	15.4	18.6	11.7	[39]
	USA, New Mexico	2007	2007 NSCH	10-17	CDC-2000[2]	16.7	15.3	18.1	16.0	20.4	11.4	[39]
	USA, Nevada	2007	2007 NSCH	10-17	CDC-2000[2]	19.0	21.9	16.0	15.2	19.4	10.8	[39]
	USA, New York	2007	2007 NSCH	10-17	CDC-2000[2]	15.8	15.1	16.5	17.1	20.3	13.8	[39]
	USA, Ohio	2007	2007 NSCH	10-17	CDC-2000[2]	14.8	18.7	10.9	18.5	22.9	14.2	[39]
	USA, Oklahoma	2007	2007 NSCH	10-17	CDC-2000[2]	13.2	18.1	8.2	16.4	17.4	15.4	[39]
	USA, Oregon	2007	2007 NSCH	10-17	CDC-2000[2]	14.7	16.2	13.3	9.6	11.0	8.2	[39]
	USA, Pennsylvania	2007	2007 NSCH	10-17	CDC-2000[2]	14.7	15.5	13.7	15.0	21.0	8.4	[39]
	USA, Rhode Island	2007	2007 NSCH	10-17	CDC-2000[2]	15.7	15.5	16.0	14.4	18.2	10.5	[39]
	USA, South Carolina	2007	2007 NSCH	10-17	CDC-2000[2]	18.5	20.8	15.9	15.3	18.4	12.0	[39]
	USA, South Dakota	2007	2007 NSCH	10-17	CDC-2000[2]	15.2	17.3	13.0	13.2	16.0	10.2	[39]
	USA, Tennessee	2007	2007 NSCH	10-17	CDC-2000[2]	15.9	14.5	17.3	20.6	23.3	17.9	[39]
	USA, Texas	2007	2007 NSCH	10-17	CDC-2000[2]	11.8	11.0	12.6	20.4	20.6	20.2	[39]
	USA, Utah	2007	2007 NSCH	10-17	CDC-2000[2]	11.7	12.1	11.2	11.4	14.7	7.9	[39]
	USA, Virginia	2007	2007 NSCH	10-17	CDC-2000[2]	15.8	16.1	15.4	15.2	16.6	13.9	[39]
	USA, Vermont	2007	2007 NSCH	10-17	CDC-2000[2]	13.8	16.4	11.1	12.9	17.0	8.4	[39]
	USA, Washington	2007	2007 NSCH	10-17	CDC-2000[2]	18.4	21.9	14.7	11.1	14.7	7.3	[39]
	USA, Wisconsin	2007	2007 NSCH	10-17	CDC-2000[2]	14.8	17.3	12.2	13.1	15.6	10.5	[39]
	USA, West Virginia	2007	2007 NSCH	10-17	CDC-2000[2]	16.6	16.9	16.4	18.9	21.8	15.7	[39]
	USA, Wyoming	2007	2007 NSCH	10-17	CDC-2000[2]	15.5	16.6	14.2	10.2	14.1	5.5	[39]
	Brazil, Pernambuco State	2006	GSHS	14-19	IOTF[1]	11.5	11.3	11.6	2.4	2.0	2.8	[25]
ASIA	China, Hong Kong	2003-04	School-based survey	11-18	IOTF[1]	7.1	9.6	4.9	2.8	3.9	1.8	[38]
					CDC-2000[2]	8.3	11.3	5.8	4.1	6.0	2.4	
	India, Manipur	2005-06	School-based survey	12-19	IOTF[1]	4.4	4.1	4.7	0.7	1.0	0.4	[26]
	Jordan, Irbid Governorate	2007	School-based survey	13-16	CDC-2000[2]	15.7	11.8	18.9	8.7	12.3	5.8	[27]

Table 3. *Continued*

Continent	Country, Region	Date of survey	Study population	Age (years)	Criteria	Overweight (%)			Obesity (%)			Ref.
						All	Boys	Girls	All	Boys	Girls	
EUROPE	Denmark, Greater Copenhagen area and 3 municipalities outside the Capital Region	2007-09	School-based survey	14-16	IOTF[1]	14.0	15.2	12.9	11.2	14.1	8.2	[28]
	France, Aquitane Region	2004-05	School-based survey	11-18	IOTF[1]	11.7	13.3	10.1	1.9	2.4	1.4	[29]
	Greece, Crete	2005-06	School-based survey	10-12	IOTF[1]	28.0	30.0	27.0	13.0	15.0	10.0	[60]
	Hungary, Szeged and Szolnok regions	2005-06	School-based survey	11-16	IOTF[1]	16.8	17.9	15.7	6.6	7.9	5.2	[30]
	Italy, North-West	2002	HBSC Study	11,13,16	IOTF[1]	-	18.3	7.1	-	2.5	1.1	[42]
	Italy, North-East	2002	HBSC Study	11,13,16	IOTF[1]	-	16.5	11.7	-	0.8	1.5	[42]
	Italy, Center	2002	HBSC Study	11,13,16	IOTF[1]	-	20.7	11.2	-	3.9	2.5	[42]
	Italy, South	2002	HBSC Study	11,13,16	IOTF[1]	-	25.7	15.7	-	4.4	0.9	[42]
	Italy, Islands	2002	HBSC Study	11,13,16	IOTF[1]	-	31.3	10.4	-	7.6	0.8	[42]
	Italy, Sardinia	1999-2001	School-based survey	11-15	IOTF1	14.9	15.4	14.6	3.7	5.1	3.2	[61]
	Italy, Sicily	1999-2001	Public school-based survey	11-15	CDC-2000[2]	18.3	18.8	17.8	11.8	15.1	8.5	[62]
	Poland, Kujawsko-Pomorskie	2005	School based survey	13-15	IOTF[1]	10.7	12.0	9.5	1.4	1.6	1.3	[31]
	Poland, Lubuskie	2005	School based survey	13-15	IOTF[1]	11.1	12.2	10.1	3.0	2.5	3.5	[31]
	Poland, Malapolskie	2005	School based survey	13-15	IOTF[1]	12.7	12.8	12.6	1.6	1.9	1.3	[31]
	Poland, Podlaskie	2005	School based survey	13-15	IOTF[1]	13.9	14.5	13.3	2.8	3.1	2.6	[31]
	Poland, Pomorskie	2005	School based survey	13-15	IOTF[1]	13.7	13.4	13.9	2.1	2.0	2.2	[31]
	Spain, Balearic Islands	2007-08	School-based survey	12-17	WHO-2007[4]	17.5	19.9	15.5	10.4	12.7	8.5	[32]
	Spain, Grand Canary	2004-05	School-based survey	12-14	IOTF[1]	21.6	21.0	22.2	7.5	7.8	7.2	[33]
	Switzerland, Canton of Vaud	2005-06	Public school-based survey	10-14	IOTF[1]	12.0	13.2	10.7	1.7	1.8	1.7	[34]
					CDC-2000[2]	10.7	11.9	9.4	3.6	4.2	3.0	
	Turkey, Edirne Province	2001	Two school-based surveys	12-17	IOTF[1]	10.9	11.3	10.6	1.9	1.6	2.1	[35]

Abbreviations: Ref. reference, IOTF, International Obesity Task Force; CDC, Center for Disease Control and Prevention; WHO, World Health Organization; 2008 SA YRBS, 2008 South African National Youth Risk Behaviour; 2007 NSCH, National Survey of Children's Health; GSHS, Global School Based Student Health Survey; HBSC, Health Behaviour in School-aged Children.

[1]Overweight and obesity, all adolescents with BMI-for-age ≥25 kg/m^2 and <30 kg/m^2 and ≥30 kg/m^2, respectively, according to the IOTF [Cole et al, 2002].
[2]Overweight and obesity, all adolescents with BMI-for-age ≥P85th and <P95th and ≥P95th, respectively, according to the CDC [Kuczmarski et al, 2002]
[3]Overweight and obesity, all adolescents with BMI-for-age >+1SD and <+2SD and >+2SD, respectively, according to the WHO [de Onis et al, 2007].
[4]Overweight and obesity, all adolescents with BMI-for-age ≥P85th and <P95th and ≥P97th, respectively, according to the WHO [de Onis et al, 2007].
[5]Mean ± SD

RECAPITULACIÓ

Actualment, la prevenció i el tractament de l'obesitat infanto-juvenil i de les seves patologies associades, constitueix un dels reptes sanitaris més importants en el nostre país. L'actuació institucional, coordinada amb l'assistència sanitària i la intervenció dels principals col·lectius socials i econòmics implicats, és imprescindible per a l'abordatge global d'aquest problema. Però el punt de partida ha de ser conèixer la nostra realitat [20].

1. Prevalença i tendències del sobrepès i l'obesitat en els adolescents de les Illes Balears (2007-2008)

Prevalença de sobrepès i obesitat (IMC). En una mateixa població adolescent, la prevalença de sobrepès i obesitat pot ser molt diferent segons la definició aplicada. Per aquest motiu, i per tal de facilitar la comparabilitat amb altres estudis, la prevalença de sobrepès i obesitat en la població adolescent de les Illes Balears ha estat estimada emprant les dues gràfiques de referència internacionals existents: OMS 2007 [34] i IOTF [13]. En el primer cas, cal assenyalar que s'han emprat els percentils 95 i 97 per edat i sexe per a definir obesitat.

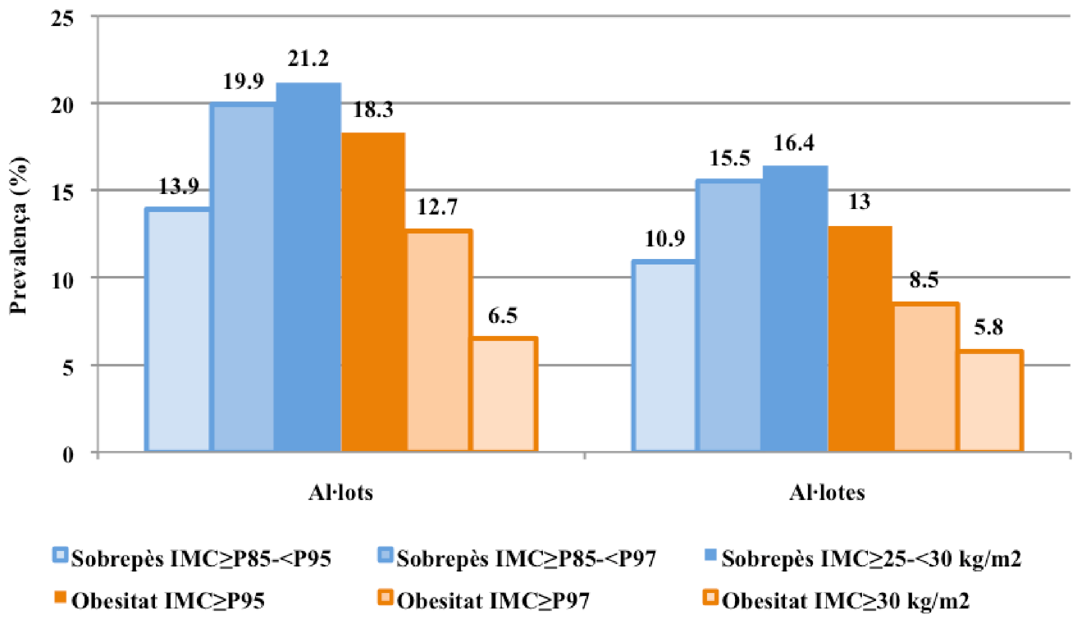

Figura 4. Prevalença de sobrepès i obesitat en els adolescents de les Illes Balears (2007-2008) per sexe. Gràfiques de referència internacionals: OMS 2007 [34] i IOTF [13].

La prevalença de sobrepès i obesitat estimada per a la població adolescent (12-17 anys) de les Illes Balears (2007-2008), d'acord a les tres definicions indicades fou: (a) emprant el percentil 95 per edat i sexe per a definir obesitat, la prevalença de sobrepès (IMC≥P85-<P95) fou de 12.3% i la prevalença d'obesitat (IMC≥P95) de 15.4%; (b) emprant el

percentil 97, la prevalença de sobrepès (IMC≥P85-<P97) fou de 17.5% i la d'obesitat (IMC≥P97) de 10.4%; (c) d'acord als criteris IOTF, la prevalença de sobrepès i obesitat fou de 18.6% i 6.1%, respectivament. En general, la prevalença d'excés de pes (sobrepès + obesitat) fou major als al·lots que a les al·lotes i, encara que la diferència percentual de cada paràmetre depèn del criteri definitori, els resultats suggereixen que la diferència radica en el sobrepès i no en l'obesitat. És a dir, en el 2007-2008 la prevalença de sobrepès en els al·lots adolescents de les Illes Balears fou major que en les al·lotes (Figura 4).

La comparació de la prevalença de sobrepès i obesitat entre diferents països i regions s'ha de realitzar amb precaució [71], però en general es pot dir que la prevalença de sobrepès i obesitat en els adolescents de les Illes Balears és similar a la d'altres països d'Europa (Xipre, Alemanya, Grècia, Irlanda, Portugal) (Figura 5).

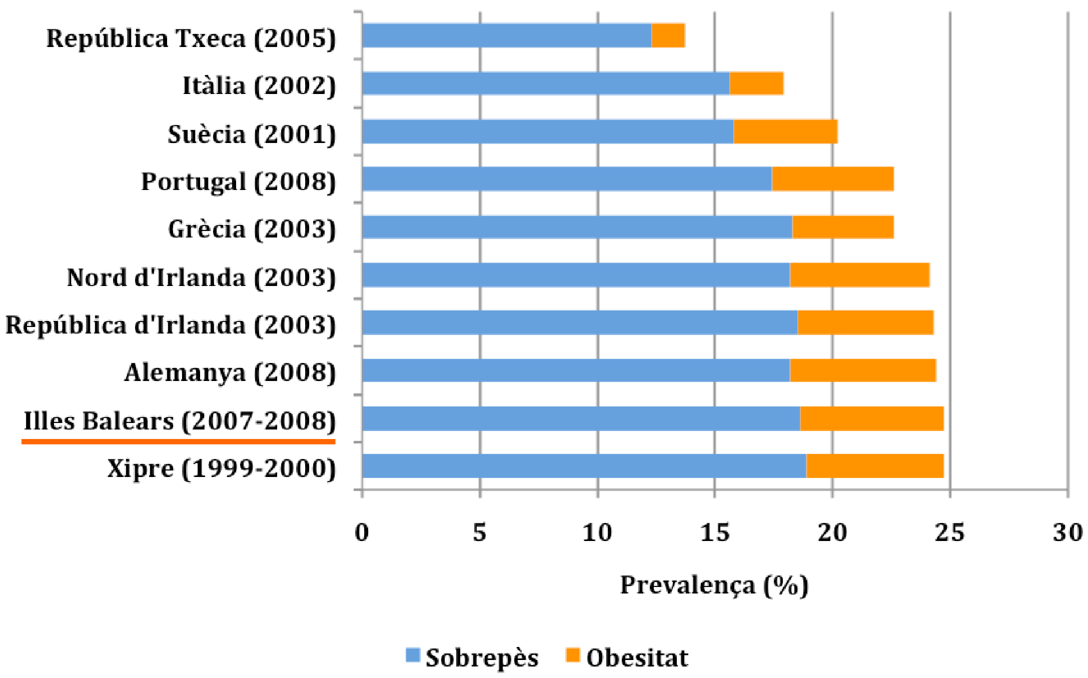

Figura 5. Prevalença (%) de sobrepès i obesitat en els adolescents de les Illes Balears en comparació amb la d'altres països d'Europa. Gràfiques de referència internacional: IOTF [13].

Per altra banda, de la comparació de les dues poblacions els resultats suggereixen un increment de la prevalença de sobrepès associat a un excés de GC a les al·lotes.

Prevalença d'excés de GC (IMG). A la població adolescent de les Illes Balears (2007-2008), mentre que el 25-28% dels adolescents tenien un pes corporal alt, només el 19.8% dels adolescents tenia excés de GC. Una vegada més, aquesta prevalença fou més alta als al·lots (27.7%) que a les al·lotes (13.2%).

Prevalença de normopès amb excés de GC i sobrepès sense excés de GC. L'IMC no és una eina precisa per a diagnosticar un excés de GC en el rang baix i mitjà de distribució [19,25]. Tot i que la definició emprada no afecta la identificació de l'adolescent amb obesitat severa, sí és important en el cas dels nins i adolescents amb sobrepès, ja que afectarà els consells, el cost i els beneficis potencials i/o perjudicials de l'exercici [23].

L'IMG en canvi, és una mesura útil per avaluar la composició corporal de forma efectiva, i els punts de tall proposats per Alvero-Cruz et al. [31] (4.58 kg/m^2 per als al·lots i 7.76 kg/m^2 per a les al·lotes) posseeixen una gran sensibilitat i especificitat com a indicadors de sobrepès en els adolescents espanyols. Però cal tenir en compte que és molt difícil eliminar l'IMC de la definició de sobrepès i obesitat. Des de petits aprenem que ésser alts i tenir un pes ideal, juntament amb una bona aparença, ens proporcionarà més possibilitats de triomfar i aconseguir els nostres objectius professionals, laborals, socials i sentimentals. Així, a la majoria de cases hi ha una bàscula que, de forma freqüent o de forma ocasional, algun component de la família utilitza per a controlar el seu pes.

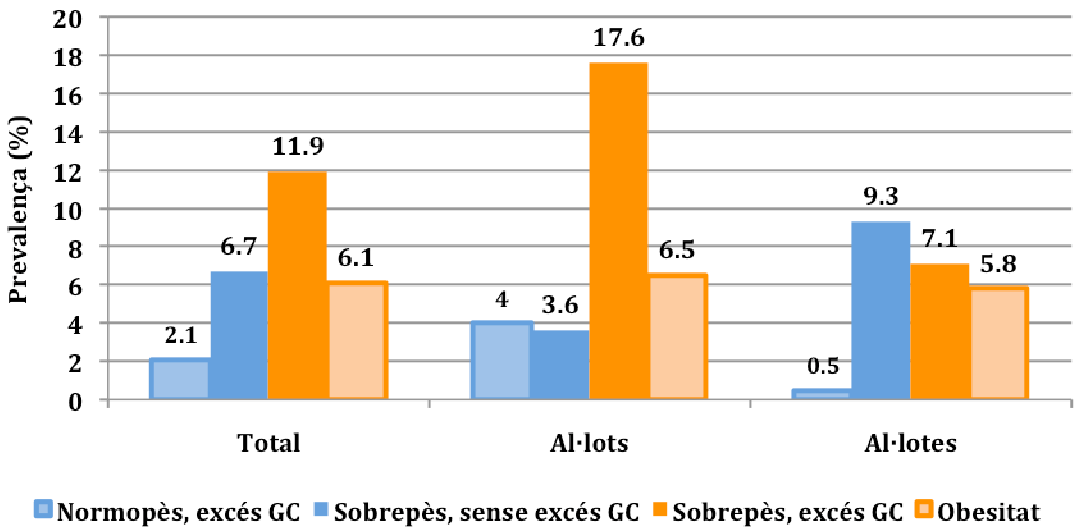

Figura 6. Prevalença d'adolescents de les Illes Balears (2007-2008) amb normopès i excés de greix corporal (GC), sobrepès amb i sense excés de GC i obesitat.

Per aquest motiu, i amb l'objectiu d'identificar aquells adolescents amb un pes normal però amb excés de GC i els que tenen sobrepès no associat a un excés de GC, d'una manera que resulti propera a la població i aplicable a la pràctica clínica i epidemiològica, s'han combinat els dos indicadors antropomètrics, l'IMC i l'IMG (Figura 6). De la combinació de l'IMC i l'IMG, els resultats indiquen que a la població adolescent de les Illes Balears un punt de tall d'IMC≥30 kg/m^2 per edat i sexe [13] és un bon indicador d'obesitat, tant als al·lots com a les al·lotes. Un punt de tall d'IMC<25 kg/m^2 [13] per edat i sexe també és un bon indicador de normopès sense excés de GC a les al·lotes. Però en canvi, en el cas dels al·lots és necessari determinar el GC en el rang de pes normal, ja que el 4% dels adolescents té un excés de GC. En el diagnòstic del sobrepès, els criteris IOTF identifiquen un percentatge important d'adolescents que no tenen en realitat un excés de GC [61]. És a dir, el 3.6% dels al·lots i el 9.3% de les al·lotes tenen un excés de pes no associat a un excés de GC o, el que és el mateix, els valors predictius positius dels criteris IOTF serien del 86.8% en els al·lots però només del 58.2% en les al·lotes.

Certament, cal assenyalar que no es pot obviar el fet que, per a calcular l'IMG a diferència de l'IMC, hi ha un pas intermedi que consisteix en aplicar una equació que permet determinar la MG i que pot incrementar l'error de classificació, ja que el valor resultant dependrà de l'equació aplicada i de la seva habilitat en l'estimació del GC. Però Rodríguez et al. [68] tot i que en comparar les equacions més emprades per a predir el GC a partir dels plecs cutanis amb DEXA van trobar que la majoria de les equacions no tenien una bona concordança amb DEXA, proposaren l'ús de les equacions de Slaughter et al. [69], tant en clínica com en epidemiologia.

Prevalença de sobrepès i obesitat amb obesitat abdominal (ICT). L'avaluació de l'obesitat abdominal és útil en la identificació dels adolescents amb un alta probabilitat de factors de risc cardiovasculars. Així, el 7.7% de la població adolescent de les Illes Balears del 2007-2008 tenia obesitat abdominal (sense diferències entre sexe). En concret, a la població adolescent de les Illes Balears 1 de cada 4 adolescents amb sobrepès i excés de GC i 1 de cada 5 adolescents obesos tindria obesitat abdominal.

2. Factors de risc d'obesitat en els adolescents de les Illes Balears

A continuació s'exposen els principals factors de risc d'obesitat identificats en la població adolescent de les Illes Balears (Figura 7).

Figura 7. Factors de risc d'obesitat avaluats als adolescents de les Illes Balears.

2.1. Factors sociodemogràfics

Sexe. La prevalença d'obesitat a la població adolescent de les Illes Balears és independent del sexe. Però en canvi, el sobrepès i l'excés de GC en si és més freqüent als al·lots que a les al·lotes.

Edat. A la literatura s'ha indicat que als adolescents, la prevalença de sobrepès (incloent-hi obesitat) disminueix amb l'edat [211]. Als adolescents de les Illes Balears també s'ha observat una relació inversa entre l'edat i l'obesitat als al·lots, però no a les al·lotes. Ara bé, l'explicació de per què als al·lots més joves (12-13 anys) el risc d'obesitat és major que en els seus companys és complexa a partir dels resultats obtinguts. Per exemple, la falta d'associació entre la prevalença d'obesitat i l'edat a les al·lotes podria estar relacionada amb un "equilibri energètic", ja que tot i que les al·lotes més joves (12-13 anys) tenen una major probabilitat de seguir un patró alimentari més "Occidental" (veure apartat 3.1), amb una adequació pobra a la DM, i el sedentarisme en aquest grup d'edat també és menor. A més, la pràctica d'AF vigorosa i el temps dedicat a aquest tipus d'AF també és major en aquest grup d'edat (12-13 anys). Però en el cas dels al·lots, no s'ha observat una relació evident entre l'edat i els principals factors responsables del desequilibri energètic relacionats amb l'obesitat (alimentació i AF). Ara bé, cal tenir en compte que l'estat puberal no s'ha avaluat en aquest estudi i, tot i que és una època clau per al desenvolupament de l'obesitat posterior [78], en el cas dels al·lots quant abans s'inicia el desenvolupament sexual, menor és el risc de sobrepès i obesitat posterior [80,81]. També cal assenyalar que mentre que el 80% dels adolescents normalitzen el seu pes corporal a l'edat adulta [78], tan sols el 20% de les adolescents obeses ho fa.

Baix nivell educatiu dels pares. En la literatura s'ha indicat que el nivell educatiu dels pares és, de fet, un dels principals factors determinants de l'obesitat [212]. Els adolescents de les Illes Balears no en són una excepció. I és que el nivell educatiu dels pares, especialment de la mare, està associat amb la qualitat de la dieta i la seva adequació i adherència a la DM, especialment en el cas de les al·lotes.

Baix nivell socioeconòmic dels pares. En els adolescents de les Illes Balears, el nivell socioeconòmic dels pares és un factor de risc d'obesitat especialment important a les al·lotes. Les al·lotes de pares amb un baix nivell socioeconòmic mostren una menor adequació de la seva dieta a la DM i una major probabilitat de seguir un patró alimentari més occidental. A més, les al·lotes de pares amb baix nivell educatiu també tendeixen a ser més sedentàries que les seves companyes amb pares de nivell socioeconòmic més elevats. Ara bé, per què el nivell socioeconòmic dels pares afecta a la dieta i la pràctica d'AF a les al·lotes i en canvi no ho afecta als al·lots? Per una banda, cal fer notar que les al·lotes en general, bé sigui per mantenir un estat de salut i complir amb les recomanacions nutricionals, bé sigui per motius estètics i prevenir o revertir l'estat d'obesitat, presten més atenció als aliments que els al·lots [54]. Però actualment, una dieta més saludable també té un cost més elevat. Per altra banda, tampoc podem descartar el fet que són els al·lots els qui normalment tenen un major suport social i familiar perquè practiquin esports [213].

2.2. Estils de vida

Omissió de menjades. En general, un 22% dels al·lots i un 41% de les al·lotes realitzen ≤3 menjades al llarg del dia, i aquests percentatges incrementen en els adolescents obesos (42% dels al·lots i 62% de les al·lotes). Probablement els adolescents obesos tendeixen més freqüentment a ometre algunes menjades perquè la ingesta energètica és major quan major és el nombre de menjades que es realitzen al llarg del dia. Però tot i així, no ens ha d'estranyar que l'omissió de menjades, sigui causa o conseqüència de l'associació inversa entre l'adipositat global i central, s'identifiqui com un factor de risc d'obesitat. El nombre de menjades està relacionat no només amb l'energia total ingerida, sinó també amb la distribució energètica i el patró alimentari. És a dir, quan es realitzen ≥5 menjades al llarg del dia, el dinar i el sopar suposen sols la meitat de la ingesta total, mentre que quan es realitzen ≤3 menjades diàries, un 80% de l'energia es consumeix en aquestes dues menjades. A més, les al·lotes que realitzen ≤3 menjades diàries també tenen una menor ingesta de carbohidrats, i una major ingesta de proteïnes i greixos.

Per altra banda, l'adequació de la dieta a la DM també és menor quan els adolescents realitzen ≤3 menjades al dia. Més concretament, en els al·lots realitzar ≥4 menjades al dia està associat amb un consum més freqüent de fruita i, probablement, de iogurts i formatge que en el cas de realitzar ≤3 menjades diàries. A les al·lotes, l'adequació de la dieta a la DM està associada amb l'hàbit d'esmorzar i, de fet, s'observa que les al·lotes que realitzen 4 menjades diàries tenen un consum més freqüent de productes làctics i cereals per a esmorzar que les que realitzen només ≤3 menjades diàries. A més, el consum d'aliments rics en greixos (brioxeria comercial, patatilles, bacon…) i el d'olis i greixos distints a l'oli d'oliva es manté inferior en el cas de realitzar 4 menjades diàries. Ara bé, cal assenyalar que en el cas de les al·lotes no hi ha diferències en l'adequació de la dieta a la DM quan es realitzen ≤3 i ≥5 menjades al dia i, de fet, els resultats suggereixen que el risc a què la dieta derivi a un patró més occidental incrementa quan es realitzen ≥5 menjades diàries.

Omissió del desdejuni. El risc d'obesitat és particularment superior en els adolescents que ometen el desdejuni. De fet, el desdejuni està associat amb la correcta nutrició dels nins i rarament és compensat per les altres menjades del dia [212].

Menjar caramels i snacks salats. En els adolescents de les Illes Balears no s'ha observat una associació significativa entre el consum de caramels i snacks salats i l'obesitat. Contràriament al que en un principi s'esperaria, els resultats indiquen una tendència a un menor risc d'obesitat quan de forma habitual es consumeixen aquests aliments. Aleshores, els adolescents obesos suprimeixen o subestimen la ingesta de caramels i snacks salats? Per una banda, cal fer notar que el nombre d'adolescents amb excés de GC que subestima la seva ingesta energètica és 4 vegades superior (37%) al nombre d'adolescents sense excés de GC (10%) que també la subestima. Per altra banda, la majoria dels adolescents amb excés de GC es troba insatisfet amb la seva pròpia IC (83% dels al·lots i 97% de les al·lotes), el que pot influir en la declaració del consum de determinats aliments. Però de fet, quan es compara la freqüència de consum de varis grups d'aliments entre els adolescents amb excés de GC amb la dels seus companys més prims –una vegada eliminats tots els individus que subestimen la seva ingesta energètica-, s'observa que els adolescents amb excés de GC i insatisfets amb la seva IC declaren un consum menys freqüent d'aliments associats amb l'engreixar, almenys de forma popular; essent especialment notori en els al·lots. Així, els al·lots amb excés de GC i insatisfets amb la seva IC declaren un menor consum de pasta i arròs, aliments rics en greixos, olis i greixos diferents a l'oli d'oliva, refrescs i xocolates; i a les al·lotes el consum de postres làctics i xocolates també és inferior al declarat per les al·lotes més primes. Però en canvi, no hi ha diferències en la declaració de la freqüència de consum dels diferents grups d'aliments entre els al·lots satisfets amb la seva IC i els més prims, observant-se en ells una tendència a una pobra adequació de la dieta a la DM.

Cal assenyalar que malgrat el 83.4% dels al·lots amb excés de GC es troba insatisfet amb la seva IC, el 40.7% indica no estar preocupat per incrementar el pes i el 34.7% declara no haver intentat perdre pes en alguna ocasió i, cas d'haver-ho intentat, només el 16.0% ho ha fet a través de la dieta i el 37.2% ha combinat dieta i AF.

Aleshores, a partir dels resultats obtinguts no podem descartar la possibilitat que els adolescents (o almenys alguns adolescents) amb excés de GC suprimeixen alguns aliments de la seva dieta com a mètode per a mantenir o reduir el seu pes corporal, encara que també és possible que tendeixin a subestimar el consum d'alguns aliments, principalment quan es troben insatisfets amb la seva IC.

Menjar mirant la TV. Menjar mirant la TV incrementa el risc d'obesitat, probablement per un efecte en la ingesta dels aliments [214], ja que la TV està inversament associada amb el consum de productes no anunciats –com les fruites i els vegetals [215]-, i anima el telespectador a un major consum d'aliments i begudes considerats "prestigiosos socialment", "sans" i/o "apetitosos", però altament processats [212].

Dormir poc. Dormir ≤7 hores diàries està associat amb un major risc d'obesitat als al·lots però no a les al·lotes. Hi ha estudis que suggereixen que els al·lots són més susceptibles a dormir menys que les al·lotes [216]; tot i que probablement sigui adequat recomanar que dormin almenys 7 hores diàries, les revisions més recents indiquen que actualment encara és precipitat suggerir que dormir una sèrie d'hores és causa o solució de l'obesitat epidèmica [217,218].

Fumar. L'adolescència és una etapa de desenvolupament psicosocial i un període clau per a l'adopció d'hàbits no saludables com el consum de tabac. Però, hi ha realment una relació entre el consum de tabac i l'obesitat en els adolescents? Les al·lotes ocasionalment fumadores presenten un major risc d'obesitat que les no fumadores. Però estudis previs han mostrat que els valors d'IMC, ingesta energètica i ingesta de greixos són similars entre els fumadors i no fumadors; tot i que un 40% dels adolescents creuen que fumar pot reduir o ajudar a controlar el pes corporal [219].

Aquesta creença podria estar relacionada amb el fet que fumar redueix l'apetit [220]. A més, com la sensibilitat que tenen les al·lotes a l'apetit és major que la dels al·lots –per diferències relacionades amb la naturalesa hormonal [220]-, és possible que les al·lotes apliquin aquest mètode per a "reduir" el seu pes corporal. Ara bé, tampoc es pot descartar que fumar sigui més aviat un factor facilitador de les relacions socials [221].

Vida sedentària. Està ben establert que un estil de vida sedentari, amb una baixa despesa energètica a les activitats físiques, és un factor de risc per a guanyar pes [177]. En els al·lots adolescents de les Illes Balears, un excés de GC està associat amb un patró d'AF més sedentari i a la inversió de menys temps en la pràctica d'activitats físiques vigoroses. Però en canvi, a les al·lotes l'associació entre la pràctica d'AF i l'obesitat depèn del criteri utilitzat. Mentre que les al·lotes amb un IMC≥P97 per edat i sexe està associat a un PAL<1.6, els resultats indiquen que en les al·lotes obeses la pràctica de 300 min d'AF setmanals és més habitual que a les al·lotes més primes. L'anàlisi antropomètrica també indica que, mentre que els al·lots adolescents actius tenen menor IMC, perímetres (cintura i maluc) i plecs cutanis (tricipital i subescapular) que els seus companys sedentaris, les al·lotes sedentàries (<300 min setmanals) són les que tenen un menor pes corporal, IMC i perímetre de maluc. Aleshores, tot i que no es pot descartar que les al·lotes obeses hagin sobreestimat la pràctica d'AF, pot ser que practiquin més AF amb l'objectiu de reduir el seu pes corporal. Aquesta hipòtesi es veu suportada pel fet que les al·lotes obeses quan intenten controlar o reduir el seu pes corporal, principalment ho fan a través de la combinació de la dieta amb l'AF (65.7%) i només el 31.4% ho intenta fent únicament dieta. Sigui com sigui, cal ressaltar que el temps que inverteixen les al·lotes obeses en activitats físiques vigoroses és inferior al temps que inverteixen les seves companyes més primes.

Ingesta energètica i origen dietètic. En general, la IE als al·lots i les al·lotes amb obesitat és menor que als adolescents no obesos, sense diferències en l'origen dietètic. Aquest efecte paradoxal podria estar atribuït a la validació dels instruments per a mesurar el consum alimentari de la població i a la possibilitat que els adolescents obesos sobreestimin el consum d'aliments sans i subestimin el consum d'aliments insans, ja que està ben documentat que els individus amb un elevat pes corporal normalment subestimen la seva ingesta alimentària [177]. Respecte a aquest darrer aspecte, cal assenyalar que els adolescents amb sobrepès i obesitat de la població estudiada podrien no ser una excepció. Però cal tenir en compte que en els al·lots, paral·lelament al menor consum d'alguns grups d'aliments (ex: cereals, pasta i arròs, aliments rics en greixos, olis i greixos diferents a l'oli d'oliva, refrescs i xocolates) observat en aquells que tenen un excés de GC i que estan insatisfets amb la seva IC, la IE mitjana (2175 kcal/dia, DE 645.7) també és inferior a la dels seus iguals satisfets (2783 kcal/dia, DE 647.5) i al·lots més prims (2581 kcal/dia, DE 645.5). A més, el percentatge d'energia ingerida en forma d'àcids grassos saturats també és inferior en els al·lots amb excés de GC i insatisfets amb la seva IC (12.6%, DE 3.6) que en els al·lots més prims (13.8%, DE 3.6). En canvi, quan es compara la IE dels adolescents amb i sense excés de GC, no s'observen diferències en la IE a les al·lotes amb i sense excés de GC, tot i que el 97% es troba insatisfet amb la seva pròpia IC.

Patrons dietètics i autopercepció de la IC. Hi ha estudis que han indicat una associació inversa entre l'obesitat i l'adherència a la DM en nins i adolescents [176,199,222-224], mentre que altres estudis no han trobat cap associació [225]. En la població adolescent balear tampoc s'ha observat associació entre la qualitat de la dieta i l'adequació de la dieta a la DM. Però, és la dieta dels adolescents amb un excés de GC menys mediterrània que la dels seus companys «més prims»? Tot i que a les al·lotes no s'observa associació directa entre el patró alimentari i la composició corporal; als al·lots, contràriament al que pensaríem inicialment, s'observa que és precisament aquells que no tenen un excés de GC on és més probable trobar el patró alimentari "Occidental" (veure apartat 3.1). És a dir, els resultats suggereixen que els al·lots més prims són els que es permeten més sovint un patró alimentari "Occidental", mentre que els adolescents amb un excés de GC i insatisfets amb la seva IC (un 83% dels al·lots amb excés de GC) són precisament els que declaren tenir un menor consum d'aliments característics d'aquest patró alimentari. A més, la baixa associació entre el desig dels al·lots per estar més prims i el patró alimentari "Occidental" dóna suport a aquest suggeriment. Tot i ésser possible que els al·lots amb excés de GC i insatisfets amb la seva IC subestimin la seva ingesta d'aliments "insans", una vegada més hem de recalcar que no podem descartar el fet que els adolescents o almenys alguns adolescents amb un excés de GC i insatisfets amb la seva IC suprimeixin la ingesta d'alguns aliments per tal de mantenir o reduir el seu pes corporal.

Cal assenyalar que aquesta associació entre l'autopercepció de la IC i el patró alimentari "Occidental" també s'observa a les al·lotes. És a dir, les al·lotes que desitgen estar més primes o bé estan interessades en mantenir la seva figura, també són les que menys sovint mostren un patró alimentari "Occidental". Però mentre que en el cas dels al·lots, el desig de perdre pes està relacionat sovint amb un excés de GC, a les al·lotes el desig d'una figura més prima de la pròpia hi és, tot i no haver-hi un excés de GC; un fet que podria explicar part de l'absència d'associació directa entre la composició corporal i el patró alimentari "Occidental" en el sexe femení.

3. La dieta dels adolescents de les Illes Balears

La dieta dels adolescents de les Illes Balears s'ha avaluat d'acord als seus patrons dietètics (incloent-hi l'adequació de la dieta a la DM) i la qualitat global.

3.1. Patrons dietètics i adequació de la dieta a la Dieta Mediterrània

En els adolescents de les Illes Balears s'han identificat dos patrons dietètics principals (els quals expliquen un 24% de la variança total): el patró "Mediterrani" i el patró "Occidental". El patró "Mediterrani" explica un 10.6% de la variança total i es caracteritza pel consum d'iogurt i formatge, carn vermella, pollastre, peix i marisc, ous, llegums, pasta, fruita, suc de fruites, verdures, patates i tubercles, i oli d'oliva. El patró "Occidental" en canvi, explica un 13.4% de la variança total i es caracteritza pel consum d'iogurt i formatge, postres làctics, carn vermella, pollastre, embotits, ous, pa, cereals, pasta, arròs, pizza, suc de fruites, fruita en conserva, fruits secs, refrescs, aliments rics en greixos, olis i greixos diferents a l'oli d'oliva, caramels i xocolata. Per altra banda, d'acord al mètode modificat derivat del Score de la Dieta Mediterrània, l'adherència mitjana de la dieta dels adolescents de les Illes Balears a la DM és del 57.9% [226]. Mentre que d'acord a l'Índex KIDMED, l'adequació a la DM és bona en un 28.9% dels adolescents de les Illes Balears, el 14.8% dels adolescents tenen una dieta pobrament adequada a la DM. Aleshores, d'aquests resultats es dedueix que els patrons dietètics dels adolescents de les Illes Balears estan en un estat de transició, amb una pèrdua del patró mediterrani tradicional cap a un patró més occidental.

Però, quins són els factors que influeixen en aquest canvi del patró alimentari dels adolescents de les Illes Balears? En general, la transició nutricional està associada tant a factors sociodemogràfics, a l'estil de vida com a la composició corporal i l'autopercepció de la IC. L'associació entre els patrons dietètics i la composició corporal i l'autopercepció de la IC ja s'ha exposat en l'apartat de factors de risc d'obesitat (veure apartat 2.2). Per tant, a continuació s'exposa l'associació entre els patrons dietètics i els factors sociodemogràfics i l'estil de vida.

3.1.1. Factors sociodemogràfics

El sexe, l'edat i el nivell educatiu i socioeconòmic dels pares són factors associats al patró alimentari dels adolescents de les Illes Balears:

Sexe. En general, la dieta de les al·lotes té una major adherència mitjana a la DM que la dels al·lots (58.7% vs. 56.9%) [226] i segueixen més freqüentment el patró alimentari "Mediterrani" que el patró "Occidental". Malgrat això, l'anàlisi de l'Índex KIDMED mostra que un major percentatge d'al·lots té una bona adequació de la dieta a la DM (32.7% dels al·lots front al 25.7% de les al·lotes), i mentre que 4 de cada 10 al·lots té una dieta pobrament adequada a la DM, 2 de cada 5 al·lotes també la té. Aleshores, a què es deu aquesta contradicció en l'adherència a la DM? Quan es compara el patró dietètic dels adolescents de les Illes Balears que tenen una bona adequació a la DM –d'acord a l'Índex KIDMED- amb els que la tenen pobra efectivament s'observa que, en general, el patró dietètic dels al·lots i les al·lotes amb una bona adequació a la DM es basa en un consum més freqüent i adequat de llet, iogurt i formatge, cereals, galetes, fruita, suc de fruites, llegum, verdures i oli d'oliva i, a la vegada, el seu consum d'aliments rics en greixos és menor. Aleshores, és evident que en general el qüestionari KIDMED –pel fet de basar-se en les premisses que el patró tradicional de DM inclou el consum de fruites i verdures, oli d'oliva, peix, llegums, cereals, fruits secs i làctics, i puntuar negativament el consum d'aliments com són els *snacks*, la brioixeria, els caramels o el *fast food* per no ser elements característics de la DM- permet fer un diagnòstic ràpid del grau d'adequació al patró de DM a la població adolescent [227]. Però cal tenir en compte que de 16 components que analitza el qüestionari KIDMED, 4 estan relacionats amb l'esmorzar (Figura 8). I precisament quan s'analitzen les diferències existents en els 16 components del qüestionari KIDMED entre els al·lots i les al·lotes, s'observa que realment són els al·lots els que aconsegueixen amb major freqüència puntuacions positives (+1) en l'hàbit d'esmorzar i en el consum de cereals o pa i productes làctics per esmorzar; a més de per al consum de pasta i arròs, fruita, iogurts i formatge i fruits secs. I és que les al·lotes tendeixen a ometre l'esmorzar amb més freqüència que els al·lots. Tot i que és cert que l'esmorzar determina la qualitat de la dieta de l'adolescent, i sovint la seva omissió no és compensada per la resta de menjades, probablement el pes que té en l'Índex KIDMED tal vegada emmascari que siguin les al·lotes les que tenen una major adherència a la DM. Tot i que efectivament un major nombre d'al·lots complirien amb les recomanacions de llet, cereals, patates i tubercles i fruits secs, també tenen un consum més freqüent dels aliments identificats en el patró alimentari "Occidental" (postres làctics, carn vermella, ous, pizza, fruita en conserva, refrescs, begudes alcohòliques i aliments rics en greixos) i un menor nombre compliria amb la recomanació de verdures. A més, de l'anàlisi de la FFQ també s'observa que no hi ha diferències en el compliment de la recomanació de consum de fruita, pasta i arròs, iogurt i formatges, suggerint que és probable que els al·lots hagin sobreestimat el seu consum en el qüestionari KIDMED.

KIDMED	**Puntuació**
Menja una fruita o suc al dia	+1
Menja una segona fruita al dia	+1
Menja vegetals (frescs o cuinats) una vegada al dia	+1
Menja vegetals (frescs o cuinats) més d'una vegada al dia	+1
Menja peix habitualment (mínim 2-3 vegades per setmana)	+1
Va a un restaurant de menjar ràpid (hamburguesa) més d'una vegada a la setmana	-1
Li agraden els llegums i en pren més d'una vegada a la setmana	+1
Menja pasta (o arròs) quasi cada dia (5 o més vegades a la setmana)	+1
Menja cereals o pa per esmorzar (*)	+1
Menja fruits secs habitualment (2-3 vegades a la setmana)	+1
Empra oli d'oliva a casa	+1
Es bota l'esmorzar (*)	-1
Pren un producte làctic per esmorzar (*)	+1
Menja alguna peça de brioixeria per esmorzar (*)	-1
Menja dos iogurts i/o formatge /40 g) al dia	+1
Menja dolços o caramels vàries vegades al dia	-1

Figura 8. Qüestionari KIDMED per a avaluar la qualitat de la dieta mediterrània. (*) Preguntes del qüestionari relacionades amb l'esmorzar. Font: Serra-Majem et al. Food, youth and the Mediterranean diet in Spain. Development of KIDMED, Mediterranean Diet Quality Index in children and adolescents. Public Health Nutr 2004;7(7):931–935.

Edat. Resulta difícil definir el patró alimentari i l'adequació de la dieta a la DM dels adolescents en funció de la seva edat, però els resultats suggereixen que mentre que el patró alimentari "Mediterrani" es pot trobar més sovint als al·lots més joves (12-13 anys), és precisament a les al·lotes d'aquesta mateixa edat on el patró alimentari "Occidental" és més freqüent. Però aquests resultats no ens han de sorprendre, ja que hem de tenir en compte que a mesura que les al·lotes es van fent més grans, també augmenta el seu desig per estar més primes. Així per exemple, mentre que el 49.4% de les al·lotes de 12-13 anys desitja una figura més prima que la pròpia, el 60.2% de les al·lotes de 16-17 anys també ho desitja i aquest fet pot estar relacionat amb una major atenció en la dieta a partir dels 16 anys, edat en què el consum mig de postres làctics, fruita en conserva i aliments rics en greixos és significativament menor que als 12-13 anys, mentre que el consum de begudes alcohòliques és major. Però, en canvi, és probable que els al·lots, a mesura que es van fent majors i van adquirint independència dels seus pares –passant a tenir els companys i els mitjans de comunicació una major influència-, modifiquin la seva dieta però cap a un detriment del patró mediterrani. Amb l'edat, en els al·lots s'incrementa el desig per a una figura més musculosa a la pròpia (34.3% dels al·lots de 16-17 anys front al 17.9% dels al·lots als 12-13 anys); de fet, precisament són els adolescents satisfets amb la seva IC els que desitgen una silueta major i els que es permeten més sovint el patró dietètic "Occidental".

Nivell educatiu i socioeconòmic dels pares. Un baix nivell educatiu dels pares, especialment de la mare, i un baix nivell socioeconòmic està associat a l'allunyament de la dieta al patró d'alimentació Mediterrani i un major seguiment del patró alimentari "Occidental", principalment en les al·lotes. No només el nivell educatiu, sinó també el cost dels aliments, són factors que poden influenciar en l'elecció dietètica dels individus, essent normalment més car de seguir un patró alimentari mediterrani que un patró occidental [228].

3.1.2. Estils de vida

Els principals factors associats al patró alimentari dels adolescents de les Illes Balears són el número de menjades diàries, el temps dedicat a mirar la TV i emprar l'ordinador, i els nivells d'AF.

Número de menjades diàries. En general, els adolescents que realitzen ≤3 menjades al dia són els que tenen una adequació de la dieta a la DM més pobra (veure apartat 2.2). També cal fer notar que no hi ha diferència en l'adequació de la dieta a la DM entre els al·lots que realitzen 4 i ≥5 menjades diàries, essent en ambdós casos major el consum de fruita i probablement d'iogurts i formatge; en el cas de les al·lotes, l'adequació de la dieta a la DM és major en el cas de realitzar-se 4 menjades, mentre que en les al·lotes que realitzen ≥5 o més menjades és més probable trobar el patró alimentari "Occidental".

Temps dedicat a mirar la TV i emprar l'ordinador. Els adolescents de les Illes Balears que estan ≥4 hores diàries mirant la TV i/o emprant l'ordinador tenen una major probabilitat de seguir el patró alimentari "Occidental" –tot i que en el cas de les al·lotes, a partir de les 2 hores diàries es comença a observar una major freqüència d'aquest patró- que els adolescents que hi estan menys hores. En general, aquests adolescents tenen un consum medi més elevat de la majoria de grups d'aliments inclosos en el patró alimentari "Occidental" (postres làctics, carn vermella, embotits, pa, arròs, suc de fruites, refrescs, aliments rics en greixos, caramels i xocolates), mentre que el consum de fruita, verdures, iogurts i formatge és considerablement més baix.

Nivell d'AF. El nivell d'AF s'ha associat amb l'elecció dels aliments en nins i adults; precisament són els nins amb majors nivells d'AF els que tenen una dieta més saludable. Els adolescents de les Illes Balears no en són un excepció, i l'adequació de la seva dieta a la DM és major en els adolescents més actius (≥300 min/setmana d'AF). Els adolescents actius tenen un consum més freqüent de cereals i fruites, el consum d'iogurts i formatge i suc de fruits també és major a les al·lotes més actives, però el consum d'aliments rics en greixos i refrescs és major en el cas de les al·lotes sedentàries.

En resum, de l'estudi dels factors sociodemogràfics i l'estil de vida dels adolescents de les Illes Balears s'observen diferències en el patró alimentari i l'adequació de la seva dieta a la DM. En general, un baix nivell educatiu i socioeconòmic dels pares, realitzar ≤3 menjades al llarg del dia, veure la TV o emprar l'ordinador ≥4 hores diàries i tenir baixos nivells d'AF (<300 min setmanals) són factors relacionats amb una baixa adequació de la dieta a la DM i una major probabilitat de seguir un patró alimentari "Occidental".

3.2. Qualitat de la dieta

L'avaluació de la qualitat global de la dieta dels adolescents de les Illes Balears d'acord a la modificació de l'Índex Internacional de la Qualitat de la dieta (DQI-I) indica que la qualitat dietètica global és deficient (puntuació mitjana de 50 d'un total de 100 punts). La dieta dels adolescents de les Illes Balears té bones puntuacions en les categories d'adequació en la ingesta de fruita, proteïna, ferro i vitamina C, i en les categories de varietat. Però té puntuacions baixes per a les categories d'adequació en la ingesta de calci i vegetals; moderació en la ingesta d'àcids grassos, àcids grassos saturats i "aliments buits" –que són aliments calòrics, però amb escàs valor nutricional-, i en el balanç en la ingesta de macronutrients i àcids grassos.

Com cal esperar, la qualitat de la dieta dels adolescents de les Illes Balears es troba influïda per factors sociodemogràfics i estils de vida. En general, una vegada més s'observa que l'edat i el nivell educatiu dels pares exerceixen un efecte important en la qualitat de la dieta dels adolescents. Per altra banda, es confirma que mirar la TV durant les menjades redueix la qualitat de la dieta dels adolescents. Els resultats reiteren que els adolescents actius són el que tenen una dieta més saludable. A més, de l'anàlisi del comportament sedentari es pot deduir que mentre que la qualitat de la dieta és inversament proporcional al temps dedicat a veure la TV i/o emprar l'ordinador, aquesta millora amb el temps dedicat a realitzar les tasques de l'institut i a estudiar. Finalment, també s'observa que són precisament els adolescents que desitgen augmentar de pes són els que es permeten una dieta menys saludable.

4. Patrons d'activitat física en els adolescents de les Illes Balears

L'adolescència constitueix l'inici de la declinació de la pràctica d'AF [229], amb una disminució anual d'un 2.7% en els al·lots i un 7.4% en les al·lotes entre els 10 i 17 anys [54]. En els adolescents de les Illes Balears, mentre que el 78% dels al·lots realitzen almenys 300 min setmanals d'AF, només el 51% de les al·lotes compleixen aquest temps. A més, mentre que 6 de cada 10 al·lotes de 12-13 anys compleixen amb els 300 min d'AF setmanals, només 4 de cada 10 al·lotes de 16-17 anys ho fan. Cal fer notar que amb l'edat, no només disminueix el nombre d'al·lotes que realitzen AF sinó també el temps que es dedica a AF vigorosa.

Ara bé, quin és el comportament sedentari dels adolescents de les Illes Balears i com influeix en la pràctica d'AF? En el cas dels al·lots, la pràctica d'AF és independent del temps dedicat a activitats sedentàries com són veure la TV i emprar l'ordinador, o el temps d'estudi i realització de les tasques de l'institut. Però en canvi, a les al·lotes la declinació de la pràctica d'AF està associada a un increment del temps dedicat a les activitats sedentàries. Així, mentre que les al·lotes de 12-13 anys són més actives físicament, les de 14-15 anys dediquen més temps a veure la TV i emprar l'ordinador, i les de 16-17 anys dediquen més temps a realitzar les tasques de l'institut i estudiar. A més, també cal esmentar que el percentatge d'al·lotes de 16-17 anys que declaren dormir menys de 7 hores diàries és 4 vegades major que en les al·lotes de 12-13 anys, fet que podria estar relacionat amb la major implicació en l'estudi que requereix el batxillerat.

5. Imatge corporal en els adolescents de les Illes Balears

Un aspecte que cal analitzar quan s'estudia la prevalença de sobrepès i obesitat d'una població o bé es realitza un diagnòstic a nivell individual és la percepció que l'adolescent té del seu cos i veure si té relació o s'aproxima a la realitat [122]. En els adolescents amb sobrepès i obesitat, el reconeixement de l'excés de GC combinat amb una certa preocupació pel propi estat de salut i uns certs nivells d'insatisfacció amb la pròpia IC, pot facilitar la promoció de conductes saludables de control del pes com l'increment en la ingesta de fruites i verdures i la realització d'AF de forma regular [230-232]. Però en l'anàlisi de la IC s'ha de contemplar no només el pes corporal sinó també el GC, ja que com s'ha indicat anteriorment l'IMC no és una eina precisa per a diagnosticar un excés de GC en el rang baix i mitjà de distribució [19,25]. Els adolescents que tenen un pes normal es poden trobar grassos per un excés de GC, mentre que adolescents amb sobrepès es poden trobar satisfets amb la seva figura pel fet que el seu alt pes no estigui associat a un excés de GC.

5.1. Autopercepció de la imatge corporal i composició corporal

En els adolescents de les Illes Balears, "només" el 3% d'al·lots amb obesitat es troben satisfets amb la seva IC. Però tot i que pràcticament la totalitat dels adolescents obesos estan insatisfets amb la seva IC, només el 35.5% dels al·lots i el 61.1% de les al·lotes amb obesitat s'identifiquen com a tal. Per altra banda, el 25% dels al·lots i el 13.9% de les al·lotes obesos declaren estar gens preocupats per un augment de pes i fins i tot el 22.6% dels al·lots mai no ha intentat perdre pes (en el cas de les al·lotes aquest percentatge només és del 2.8%). Entre els adolescents amb sobrepès associat a un excés de GC, tot i que "només" el 16.5% dels al·lots i el 6.4% de les al·lotes declaren estar satisfets amb la seva figura, la despreocupació per l'augment de pes (39.1% en els al·lots i 12.5% en les al·lotes) i l'absència d'intent de perdre pes en alguna ocasió (32.6% en els al·lots i 16.7% en les al·lotes) també és elevada i fins i tot major que en el cas dels adolescents obesos (excepte en la despreocupació per l'augment de pes en les al·lotes, que és similar en ambdós grups). Contràriament, del 4% dels al·lots amb un pes normal però que té un excés de GC, el 14.3% es considera obès (percentatge fins i tot superior que en el cas dels al·lots de major pes i excés de GC, ~12%). Però el 71.4% d'aquests al·lots tampoc està preocupat pel seu pes; tot i que el 62% desitja aprimar-se, només el 38.1% ho ha intentat en alguna ocasió.

Per altra banda, entre els adolescents amb sobrepès no associat a un excés de GC, 4 de cada 10 al·lots està satisfet amb la seva figura i el 16% dels insatisfets desitgen una figura major, segurament més musculosa, mentre que al 89% de les al·lotes li agradaria tenir una figura més prima i esvelta que la pròpia (de fet, el 52.8% desitja la figura 3 de l'escala de Stunkard). Per altra banda, mentre que cap dels al·lots amb sobrepès sense excés de GC s'identifica com a obès i més de la meitat no es troba preocupat per un augment de pes (55.6%) i/o ha intentat perdre pes en alguna ocasió (66.7%), el 28% de les al·lotes es consideren obeses, i un alt percentatge es preocupa pel seu pes (86.3%) i ha intentat perdre pes (86.3%).

Finalment, cal assenyalar que la insatisfacció amb el pes corporal no només s'observa en els adolescents amb un alt pes corporal i/o excés de GC. Sinó que més de la meitat dels al·lots (53.4%) i les al·lotes (61.9%) amb un pes normal i sense excés de GC estan insatisfets amb la seva figura. Però en aquest grup d'adolescents és important indicar que mentre el 73.3% dels al·lots desitgen una figura més gran, segurament més musculosa; el 83.3% de les al·lotes trien una figura més prima de la pròpia. A més, mentre que el 77.1% dels al·lots no es troba preocupat amb el seu pes, només el 38.3% de les al·lotes tampoc hi està i el 41.9% ha intentat perdre pes en alguna ocasió.

5.2 Autopercepció de la imatge corporal i nivells d'activitat física en els adolescents de les Illes Balears

Cal indicar que en els al·lots adolescents de les Illes Balears, el fet de desitjar mantenir la figura està relacionat amb ser més actiu físicament; és a dir, és molt probable que els al·lots més actius es trobin més satisfets amb la seva IC, motivant-los a la vegada a continuar realitzant AF i no ens ha d'estranyar que els al·lots que desitgen una figura més prima realment siguin més sedentaris, ja que els al·lots obesos són generalment més sedentaris. Però en el cas de les al·lotes, la pràctica regular d'AF és independent de l'autopercepció de la IC i probablement a les al·lotes estigui més associada a l'estat corporal, ja que generalment les al·lotes desitgen una figura més prima. Així, mentre que el 65.7% de les al·lotes obeses en intentar perdre pes combinen dieta-AF com a mètode per reduir el seu pes, la resta d'al·lotes apliquen tant l'AF (30.1%), les dietes (30.9%) com la combinació dieta-AF (38.4%).

5.3. Ideal de bellesa i composició corporal en els adolescents de les Illes Balears

De l'anàlisi de l'escala de Stunkard [201] (Figura 9) s'observa que el 2007-2008 les siluetes més desitjades pels adolescents de les Illes Balears foren la silueta 4 en els al·lots (45.3%) i la silueta 3 en les al·lotes (49.6%). És a dir, mentre els al·lots tendeixen a preferir un cos prim però a la vegada musculós, les al·lotes normalment prefereixen una figura prima i esvelta. Però cal assenyalar que les al·lotes amb sobrepès associat a un excés de GC i obesitat freqüentment elegeixen una figura major a la silueta 3 (el 63.5% elegeix la silueta 4 i el 10.8% la silueta 5). Aleshores, podria aquest fet estar associat amb una disminució de la pressió autoimposada per a un cos tan prim? En la literatura s'ha suggerit que en els adolescents podria estar disminuint la insatisfacció amb la pròpia IC [105]. En el cas de les al·lotes adolescents de les Illes Balears, tot i que no s'observen diferències en el patró de silueta desitjada en les al·lotes amb sobrepès i obesitat de les dues poblacions, sí hi ha un augment de les al·lotes amb pes normal que seleccionen la silueta 4 com a preferida. Així, mentre que en la primera etapa 2 de cada 10 al·lotes amb normopès seleccionaven la silueta 4 com a ideal, en la segona etapa ho han fet 3 de cada 10 al·lotes. Però a les al·lotes amb pes normal no només s'ha incrementat el percentatge d'al·lotes que es conformen amb una silueta 4, sinó també el nombre d'al·lotes que no estan gens preocupades per un augment de pes (49.8% vs. 38.3%) i les que declaren no haver intentat perdre pes en alguna ocasió (50.6% vs. 41.9%). Aleshores, els resultats suggereixen que en les al·lotes, en general, podrien estar augmentant la conformitat amb una figura no tan prima, però que compleixi amb els estàndards de bellesa femenins, però sense reduir-se el percentatge d'al·lotes que trien una figura preocupantment prima, la silueta 2 (22% de les al·lotes amb un pes normal).

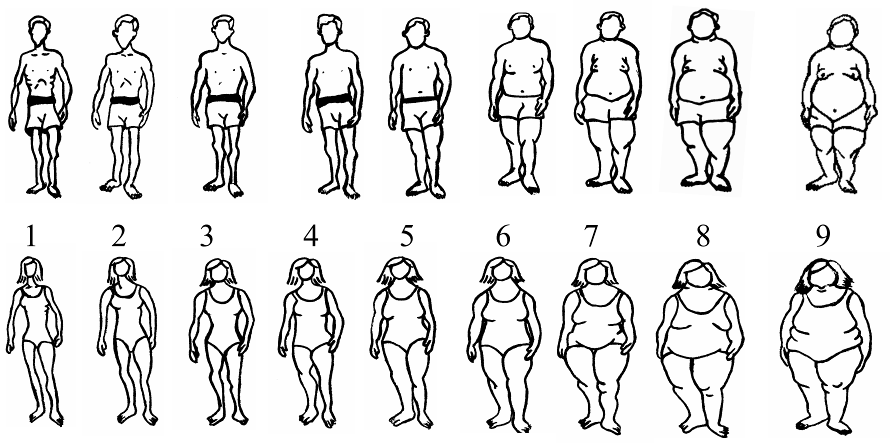

Figura 9. Escala de Stunkard [201] modificada per a l'anàlisi de la imatge corporal.

En el cas dels al·lots obesos, els resultats també suggereixen una emergent acceptació d'una figura no tan prima. Mentre que la primera població d'estudi preferia la silueta 4 com a ideal, la segona població mostrava una preferència similar per a les siluetes 3 a 5. L'increment en l'interès per la silueta 5 s'observa tant en els al·lots amb un pes normal (amb i sense excés de GC) com en els al·lots obesos. Probablement, mentre que en els al·lots amb normopès estigui associat amb la preferència per a un cos major i més musculós (d'acord al patró de preferència masculí), en els al·lots obesos l'increment en l'interès per la silueta 5 podria estar relacionat amb aquesta emergent acceptació d'una silueta major dins de l'estàndard saludable. Cal fer notar que en els al·lots, no només estaria sorgint una acceptació a certs nivells d'adipositat, sinó que també estaria emergent un interès per a una figura encara més prima, ja que en la segona etapa d'estudi és major el nombre d'al·lots que prefereixen la silueta 3, tant en el grup amb normopès com obesitat.

6. Prevalença de síndrome metabòlica en els adolescents de les Illes Balears (2007-2008)

La prevalença de SMet en els adolescents de les Illes Balears, d'acord al criteri de l'ATP III adaptat per De Ferranti et al. [209], és del 5.8% (2007-2008). Aquesta prevalença és major als al·lots (10.5%) que a les al·lotes (2.7%). A més, el SMet és més freqüent en els adolescents obesos (45.5%) que en els adolescents amb sobrepès (10%) i amb normopès (1.8%). Però la proporció d'adolescents amb almenys un component del SMet és del 49.7%, essent la hipertensió el component més comú (27.1%), la hiperglucèmia (0.6%) el menys freqüent i la prevalença de baixos nivells de colesterol HDL, hipertrigliceridèmia i obesitat abdominal similars (16.5%, 14.9% i 15.5%, respectivament). En el cas particular dels adolescents amb SMet, la hipertrigliceridèmia (90.5%), la tensió arterial alta (85.7%), els baixos nivells de colesterol HDL (78.9%) i l'obesitat central (71.4%) són components habituals, mentre que la hiperglucèmia és infreqüent.

Per altra banda, cal indicar que s'ha observat una relació inversa entre l'adherència a la DM i el SMet. A més, els resultats indiquen que l'adherència a la DM en els adolescents de les Illes Balears està associada amb una menor prevalença d'anormalitats lipídiques (hipertrigliceridèmia i baixos nivell de colesterol HDL). Per tant, una alta adherència a la DM podria dificultar el desenvolupament de mecanismes perjudicials involucrats en la gènesi de desordres metabòlics.

ALTRES QÜESTIONS D’INTERÈS

1. LIMITACIONS DE L'ESTUDI

Alimentació i activitat física

Les dades d'alimentació i AF es basen en l'autodeclaració [175]. La literatura indica que la subestimació dels aliments sovint està associat amb el sexe i el pes corporal [233;234]. L'autodeclaració de l'AF també pot ser sobreestimada a causa del desig social [235;236]. Malgrat això, en molts casos l'autodeclaració és l'únic mètode factible per a avaluar l'AF [237] i la ingesta alimentària en els estudis epidemiològics. Tot i que els epidemiòlegs fan el possible per a obtenir les dades més precises possibles, existeix la possibilitat d'una declaració errònia [175].

Activitat física. A la literatura hi ha diferències metodològiques importants en l'ús d'instruments i punts de tall, fet que sovint impedeix la comparació entre els estudis [238]. Els qüestionaris tenen limitacions inherents, sobretot perquè són de naturalesa subjectiva. L'autodeclaració de l'AF pot conduir a exagerar l'AF a causa d'un biaix de desig social i, en conseqüència, el nombre de subjectes inactius pot ser menor que el declarat [235,236], especialment entre els nins i adolescents, però també entre els obesos [235]. Per altra banda, els hàbits sedentaris poden ser més difícils de recordar que les activitats de major intensitat [239] i, de fet, s'ha indicat un biaix en el record de l'autodeclaració de comportaments sedentaris entre els adolescents [240]. Per tant, els mètodes objectius són preferibles en l'avaluació de les dimensions de l'AF en els joves [237]. De fet, a la literatura s'ha indicat una ampla gama d'instruments per a mesurar l'AF, però aquests elements han de complir els requisits d'ésser relativament econòmics, causar els mínims inconvenients per al participant i ésser capaços d'administrar-se amb relativa facilitat [241]. És per això que en els estudis epidemiològics, l'autodeclaració sol ser més factible per a avaluar l'AF, especialment quan es tracta d'estudis a gran escala [237].
A més, cal indicar que la capacitat de convertir aquestes dades a les estimacions de despesa d'energia a intensitats baixes i altes d'esforç requereixen aclariments [242]. La intensitat de l'AF ha d'ésser avaluada en relació a la capacitat fisiològica de cada persona, en funció del metabolisme basal o la capacitat aeròbica màxima.

Recordatori de 24 hores. Els recordatoris de 24 hores proporcionen informació sobre la ingesta d'aliments; com que la recol·lecció de les dades es produeix després del seu consum, aquest mètode no afecta l'elecció individual dels aliments en un dia determinat [243]. Així i tot, és necessari administrar dos recordatoris no consecutius per a avaluar la ingesta habitual, reduint la dependència en el consum al dia anterior i la disponibilitat d'aliments a casa [243].

Però encara que els recordatoris de 24 hores recullen dades poc després de la ingesta, també tenen limitacions relacionades amb la memòria i els prejudicis [243]. Dificultats per avaluar la grandària de les porcions també poden contribuir a una subestimació de la IE [244]. De fet, molts adolescents varen trobar difícil estimar el consum d'alguns aliments. Cal assenyalar que les dificultats en l'avaluació d'aliments amb un alt contingut energètic pot fer que el seu consum sigui subestimat, podent tenir un gran efecte sobre la validesa dels casos enregistrats de la IE [244]. La subestimació i sobreestimació contribueixen de manera significativa al biaix sistemàtic de l'autodeclaració de les avaluacions de la dieta, augmentant o disminuint les estimacions de la incidència de la ingesta inadequada i distorsionant la relació entre la ingesta de nutrients i la salut. Per tant, és evident que hi ha deficiències reals en els estudis de la dieta.

Per a resoldre aquestes deficiències, s'ha assenyalat [245] que els estudis de la dieta haurien d'incloure un procediment de validació interna. Els marcadors biològics de la IE s'ha proposat per a desenvolupar un paper útil en l'avaluació de la dieta, especialment per als components dels aliments que són molt variables entre les diferents mostres del mateix aliment. Malgrat això, els marcadors biològics tenen moltes limitacions [246], però a qualsevol aplicació específica s'ha de considerar acuradament els avantatges i les limitacions de cadascun, i en la base epidemiològica nutricional es mantindrà l'avaluació de la ingesta dietètica.

Qüestionari de freqüència de consum. El QFC no diferenciava entre el pa blanc i l'integral. Malgrat això, Ribas-Barba et al. [247] han indicat que el percentatge de consumidors de pa integral diari entre la població de 10-75 anys de Catalunya és petit (14.2%), amb un alt percentatge de no consumidors de pa integral (71.3%). Per tant, és d'esperar que el pa consumit sigui principalment pa blanc.

Patrons dietètics. Els mètodes estadístics generalment aplicats en epidemiologia nutricional per a definir els patrons dietètics sobre la informació dietètica recollida contenen un enfocament posterior, com l'agrupació de conglomerats i l'anàlisi factorial; o anterior com són els índexs de dieta [248]. En el present estudi, a part d'alguns índexs també s'ha aplicat l'anàlisi factorial, que és una tècnica útil per a resumir els patrons d'alimentació i relacionar-los amb diferents nivells socioeconòmics i els factors d'estils de vida [166] i l'autopercepció de la IC. Malgrat això, cal indicar que el mètode és específic de les dades i, per tant, els patrons i les seves associacions extretes en una població d'estudi no poden ser reproduïts en altres poblacions [166,249]. Però aquest tipus d'anàlisi pot facilitar el desenvolupament d'intervencions dirigides a modificar els patrons d'alimentació, en lloc de components específics de la dieta [166].

Composició corporal

El GC es va calcular aplicant les equacions de Slaughter et al. [69] prèviament suggerides per Rodríguez et al. [68]. Malgrat això, cal indicar que el present estudi no va tenir en compte el desenvolupament puberal, tot i que l'edat cronològica pot variar dràsticament durant aquesta etapa de la vida. Per aquest motiu, els adolescents foren dividits en dos grups: pubertat (12 a 14 anys) i post-puberal (15 a 17 anys) [250].

Síndrome metabòlic

Es tracta d'un estudi transversal, fet que limita la suposició sobre la duració dels criteris de SMet i, per tant, no es poden fer inferències causals. Malgrat això, estudis previs [251,252] han demostrat que la hipertrigliceridèmia i la pressió arterial a la infància estan directament associats amb nivells més alts en l'edat adulta.

2. PROPOSTES D'APLICACIÓ CLÍNICA I EPIDEMIOLÒGICA

2.1. Millora de la definició clínica i epidemiològica del sobrepès i l'obesitat juvenil: classificació AFAD-A

La vigilància, prevenció i tractament de l'obesitat infanto-juvenil requereix de mètodes de definició que siguin simples com per ésser aplicats a la pràctica clínica i epidemiològica, però que també siguin vàlids [29,253]. Però la identificació dels adolescents amb un pes normal i amb sobrepès sense excés de GC també és important, no només perquè tenen un major risc de condicions de comorbiditat relacionada amb l'adipositat [24], sinó també per les complicacions psicosocials derivades de l'excés de GC [254]. Per altra banda, i tenint en compte que precisament és el greix abdominal el més perjudicial, aconseguir una estimació fiable i precisa del GC i la distribució del greix és essencial en els entorns clínics i epidemiològics.

Els resultats d'aquest estudi donen suport al fet que s'hauria de recomanar no només l'ús d'IMC, sinó també l'ús de l'IMG i ICT sempre que sigui possible (classificació AFAD-A), tant en els entorns clínics com epidemiològics. Per tal de facilitar la feina als clínics i epidemiòlegs, s'ha proposat un qüestionari que resumeix la classificació AFAD-A (Taula 12).

Taula 12. Qüestionari per a la classificació dels adolescents d'acord al seu pes corporal, adipositat i distribució del greix (classificació AFAD-A)

Qüestió	Resultat
1. Quin índex de massa corporal (IMC, kg/m^2) té el subjecte d'acord al seu sexe i edat (aplicant els punts de tall de Cole at al., 2000 [13] proposats per la IOTF?	
a. IMC per edat i sexe <25 kg/m^2 (passar a la *pregunta 2*)	***Normopès***
b. IMC per edat i sexe ≥25 i IMC<30 kg/m^2 (passar a la *pregunta 3*)	***Sobrepès***
c. IMC per edat i sexe ≥30 kg/m^2 (passar a la *pregunta 4*)	***Obesitat***
2. Si el subjecte té ***normopès***: Quin índex de massa grassa (IMG, kg/m^2) té el subjecte d'acord al seu sexe?	
a. Al·lots: IMG<4.58 kg/m^2; al·lotes: IMG<7.76 kg/m^2.	***Normopès sense excés de GC***
b. Al·lots: IMG≥4.58 kg/m^2; al·lotes: IMG≥7.76 kg/m^2.	***Normopès amb excés de GC***
3. Si el subjecte té ***sobrepès***: Quin índex de massa grassa (IMG, kg/m^2) té el subjecte d'acord al seu sexe?	
a. Al·lots: IMG<4.58 kg/m^2; al·lotes: IMG<7.76 kg/m^2.	***Sobrepès sense excés de GC***
b. Al·lots: IMG≥4.58 kg/m^2; al·lotes: IMG≥7.76 kg/m^2 (passar a la *pregunta 4*).	***Sobrepès associat a un excés de GC***
4. Si el subjecte té ***sobrepès associat a un excés de GC*** o ***obesitat***: Quin índex de cintura:talla (ICT) té el subjecte (independentment del sexe i l'edat)?	
a. ICT<0.5.	***Sobrepès associat a excés de GC o obesitat de tipus I***
b. ICT≥0.5.	***Sobrepès associat a excés de GC o obesitat de tipus II***

Abreviatures: GC, greix corporal.

Cal assenyalar que seran necessàries més investigacions que avaluïn la utilitat de la classificació i el qüestionari AFAD-A. Ara bé, aquesta proposta podria ser el punt de partida cap a una millora en la definició tradicional de pes normal, sobrepès i obesitat, sense renunciar al concepte tradicional de mantenir un pes saludable –més proper i arrelat en la població-; i d'utilitat pràctica tant en clínica com en epidemiologia, aconseguint unificar els criteris en ambdós camps.

2.2. Disseny d'un pla regional d'intervenció sobre el sobrepès i l'obesitat juvenil

Els resultats del present estudi suggereixen la necessitat d'elaborar un pla d'intervenció regional en la població infanto-juvenil que contribueixi a estendre la pràctica d'hàbits saludables en un sector de la població molt sensible [255]. Una dieta saludable i una AF suficient i regular són els principals factors per a aconseguir i mantenir un bon estat de salut tota la vida [255].

Però no és objectiu d'aquesta tesis el disseny d'aquest pla d'intervenció, tot i que sembla pertinent establir una sèrie de suggeriments per a la seva elaboració, derivades dels resultats obtinguts en aquesta tesis:

i. S'ha de contemplar la prevenció del sobrepès i l'obesitat juvenil des de l'etapa infantil. A més, la prevenció ha d'anar encaminada al diagnòstic del sobrepès i, en concret, de l'excés de GC.

ii. S'han de prioritzar les intervencions en els grups amb major risc de sobrepès i obesitat, que coincideix amb els sectors de nivells educatius i socioeconòmics més baixos.

iii. S'ha de considerar l'autopercepció de la IC en els adolescents amb excés de GC perquè el pla d'intervenció sigui efectiu i perquè, si bé pot no modificar la freqüència de consum d'alguns aliments i de la ingesta energètica, almenys pot modificar la seva declaració.

iv. S'ha de promoure una alimentació saludable i equilibrada i la pràctica regular d'AF, conscienciant els menors d'edat dels beneficis d'una dieta equilibrada i saludable, així com del seu paper protector front a la temuda obesitat. Per això,

   a. S'ha de promoure una alimentació saludable i equilibrada tenint com a base la DM i fomentant 5 menjades diàries amb una distribució orientativa de les necessitats nutritives al llarg del dia en la proporció: 25% entre l'esmorzar i el berenar de mitjan matí, 35% al dinar, 10% al berenar de mitja tarda i 30% al sopar [255]. A més, s'ha de fomentar no la prohibició, sinó la moderació en el consum de dolços, refrescs i snacks.

   b. S'ha d'estimular els adolescents a que duguin una vida activa, reduint l'oci sedentari dedicat a veure la TV, l'ordinador i les consoles, al temps que dedicant-hi part del seu temps d'oci a la pràctica d'algun esport [255].

v. S'ha de prevenir que els adolescents facin dieta pel seu compte.

vi. S'han de tenir en compte les característiques del període adolescent, comprenent la dificultat que suposa que els consells saludables siguin realment considerats i adoptats per tal d'aconseguir uns bons resultats en la intervenció.

CONCLUSIONS

CONCLUSIONS

1. La prevalença de sobrepès (IMC≥P85-<P97) i obesitat (IMC≥P97) en els adolescents de les Illes Balears és de 17.5% i 10.4%, respectivament, similar a la d'altres països d'Europa.

2. Els principals factors associats a l'obesitat han estat:

   2.1. *Sexe i edat.* La prevalença d'obesitat és similar entre els al·lots i les al·lotes, però la prevalença de sobrepès i d'excés de greix corporal és major en els al·lots i disminueix amb l'edat.

   2.2. *Nivell educatiu i socioeconòmic dels pares.* Un baix nivell educatiu dels pares és inversament proporcional a la prevalença d'obesitat. Un baix nivell socioeconòmic dels pares també està inversament associat amb la prevalença d'obesitat però només en les al·lotes, per influència sobre la dieta i la pràctica d'activitat física.

   2.3. *Número de menjades.* A menor nombre de menjades diàries major prevalença d'obesitat.

   2.4. *Dormir.* Dormir 7 o menys hores diàries s'associa a un major risc d'obesitat als al·lots.

   2.5. *Consum de tabac.* El consum ocasional de tabac a les al·lotes s'associa a l'obesitat.

   2.6. *Nivells d'activitat física.* Els adolescents obesos són més sedentaris. Les al·lotes obeses dediquen més temps a l'activitat física setmanal, però menys temps en activitat física vigorosa que les seves companyes més primes.

   2.7. *Ingesta energètica.* Paradoxalment, la ingesta energètica és menor en els adolescents obesos, però cal indicar que als al·lots el desig d'aprimar-se està inversament associat amb la ingesta energètica.

3. Els adolescents de les Illes Balears es troben en una situació de transició nutricional. L'adherència a la Dieta Mediterrània és del 57.9% i només el 28.9% dels adolescents tenen una bona adherència a la Dieta Mediterrània. A més, s'identifiquen dos patrons dietètics principals: el patró dietètic "Occidental" i el patró dietètic "Mediterrani".

4. Un baix nivell educatiu i socioeconòmic dels pares, realitzar 3 o menys menjades al llarg del dia, veure la TV o emprar l'ordinador quatre o més hores diàries i tenir baixos nivells d'activitat física són factors relacionats amb una baixa adherència a la Dieta Mediterrània i una major probabilitat de seguir un patró dietètic "Occidental".

5. La qualitat global de la dieta dels adolescents de les Illes Balears és deficient. El comportament sedentari és inversament proporcional a la qualitat de la dieta i només hi ha una millora quan les activitats sedentàries són tasques d'estudi. La imatge corporal és un factor determinant de la qualitat de la dieta. Els adolescents que desitgen augmentar de pes es permeten una dieta menys saludable.

6. La prevalença de sedentarisme en els adolescents de les Illes Balears és de 37.1% (22.0% als al·lots i 50.8% a les al·lotes). Als al·lots els nivells d'activitat física i el comportament sedentari són independents un de l'altre; a les al·lotes, la disminució de la pràctica d'activitat física s'associa a un increment del temps dedicat a veure la TV i/o emprar l'ordinador (principalment als 14-15 anys) i a estudiar (principalment als 16-17 anys).

7. La combinació de l'IMC i l'IMG és útil en l'avaluació de l'autopercepció de la imatge corporal. La insatisfacció amb la pròpia imatge s'observa en adolescents amb elevat pes corporal i/o excés de greix corporal. Més de la meitat dels al·lots i les al·lotes amb normopès i sense excés de greix estan insatisfets amb la seva figura. El 73.3% dels al·lots amb normopès sense excés de greix desitgen una figura major i més musculosa, i el 83.3% de les al·lotes la volen més prima.

8. La prevalença de la Síndrome Metabòlica en els adolescents de les Illes Balears és del 5.8%. Aquesta prevalença és major als al·lots (10.5%) que a les al·lotes (2.7%). Una alta adherència a la Dieta Mediterrània dificulta la gènesi d'aquesta patologia.

9. Els criteris IOTF tenen una especificitat alta per al diagnòstic de l'obesitat en la població adolescent de les Illes Balears, però per a tenir un diagnòstic més precís de normopès i sobrepès, seria convenient determinar l'IMG. Es proposa la classificació AFAD-A (*Adiposity & Fat Distribution classification for adolescents*), com a eina diagnòstica útil tant en la pràctica clínica com epidemiològica.

10. Els resultats d'aquest estudi complementen la informació existent sobre sobrepès i obesitat, i suggereixen que se segueixi avaluant l'evolució de la prevalença de sobrepès i obesitat i de la Síndrome Metabòlica a les Illes Balears, però aplicant un pla d'intervenció regional, així com determinar l'aplicabilitat i utilitat de la classificació AFAD-A.

1. The overweight (BMI≥P85-<P97) and obesity (BMI≥P97) prevalence among the Balearic Islands' adolescents was 17.5% and 10.4%, respectively; similar to other European countries.

2. The main factors associated with obesity were:

   2.1. *Sex and age.* While no difference in obesity prevalence was found among boys and girls; overweight and overfat prevalence were higher among boys than girls and decreased with age in them.

   2.2. *Parental educational and socio-economic level.* A low parental educational is inversely associated to obesity prevalence. A low parental socio-economic status is also inversely associated to obesity prevalence in girls, influencing diet and physical activity practice.

   2.3. *Eating frequency.* The smaller number of meals per day, the higher prevalence of obesity.

   2.4. *Sleep.* Sleep 7 or fewer hours per day is associated with an increased risk of obesity in boys.

   2.5. *Smoking habit.* The occasional consumption of tobacco is associated with obesity in girls.

   2.6. *Physical activity levels.* Obese adolescents are the most sedentary. Obese girls show higher weekly time devoted to physical activity, but lower time devoted to vigorous physical activity than their leaner counterparts.

   2.7. *Energy intake and diet quality.* Paradoxically, the energy intake is lower in obese adolescents, but it should be noted that the desire to lose weight is inversely associated with energy intake in boys.

3. Balearic Islands' adolescents are in a nutritional transition. Adherence to the Mediterranean diet was 57.9% and only 28.9% of adolescents have an optimal adherence to the Mediterranean diet. Moreover, we have identified two mainly dietary patterns: the "Western" dietary pattern and the "Mediterranean" dietary pattern.

4. A low parental educational level and socio-economic status, eating 3 or less occasions per day, spending 4 or more hours per day watching TV and/or using the computer,

and to be physically inactive are factors associated with a low adherence to the Mediterranean diet and to be more likely to follow the "Western" dietary pattern.

5. Overall diet quality of Balearic Islands' adolescents is deficient. The sedentary behavior is inversely associated to quality diet and only time spent on homework is directly associated with diet quality. Body image is a determinant of diet quality. Adolescents who desire to be thicker allow themselves a low healthy diet.

6. The prevalence of sedentary behaviour among adolescents is 37.1% (22.0% in boys and 50.8% in girls). A displacement of physical activity to sedentary pursuits in girls with age has been observed increasing, time is spent watching TV and/or using the computer (mainly in girls aged 14-15 years) and homework (mainly in girls aged 16-17 years); whereas in boys the use of media-screen or homework time would not necessarily affects the time devoted to physical activity practice.

7. To combine body mass index (BMI, kg/m^2) and fat mass index (FMI, kg/m^2) is useful in assessing self-perception of body image. Dissatisfaction with one's own image is observed in adolescents with high body weight and/or excess body fat. More than half of boys and girls with normal-weight and without excess fat are dissatisfied with their body image. The 73.3% of boys with normal-weight but no fat excess wish high muscular body shape, and 83.3% of girls wish a thinner body shape.

8. The Metabolic Syndrome prevalence in Balearic Islands' adolescents is 5.8%. This prevalence is higher in boys (10.5%) than girls (2.7%). A high adherence to the Mediterranean diet hinders the genesis of this pathology.

9. The IOTF criteria have high specificity for diagnosis of obesity in Balearic Islands' adolescent population, but to get a better diagnosis of normal-weight and overweight, it is desirable to determine the fat mass index (FMI). It has been proposed the AFAD-A classification (*Adiposity & Fat Distribution classification for adolescents*), as an useful diagnostic tool in both clinical practice and epidemiology.

10. The results of this study complement previous information on overweight and obesity, and suggest the need to continue on the assessment of the evolution of the prevalence of overweight and obesity and the Metabolic Syndrome in the Balearic Islands, applying a regional action plan, as well as to determine the applicability and usefulness of the AFAD-A classification.

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"¿Me podrías indicar, por favor, hacia dónde tengo que ir desde aquí?"

"Eso depende bastante de adónde quieras llegar", contestó el Gato.

"A mí no me importa demasiado dónde…" empezó a explicar Alicia.

"En este caso, da igual hacia dónde vayas…", interrumpió el Gato.

"… siempre que llegue a alguna parte", terminó Alicia a modo de explicación.

*"Oh, **siempre llegarás a alguna parte**" dijo el Gato, "**si caminas lo bastante**".*

Lewis Carrol, "Alicia en el País de las Maravillas"

Imatge: http://www.alice-in-wonderland.net/alice2a.html