

Associated factors of obesity in Spanish representative samples

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Abstract

Given the dramatic increase in the prevalence of obesity and the serious health and economic consequences, the scientific community, health professionals and health agencies are looking for the best strategies to prevent/fight this trend.

In order to plan the most appropriate intervention measures the first step is to identify the associated factors of obesity. This paper presents the results of research conducted/coordinated by our research team and promoted by the Spanish Food Safety Agency (AESAN), in the last five years. These studies were focussed on representative samples of the Spanish population, paying attention to the condition of overweight/obesity and their associated factors.

The first study, FANPE ("Fuentes alimentarias de nutrientes de la población española") (2009), was centered in 418 adults (18-60 years) from 15 provinces (30 sampling points). Its aim was to analyze the dietary sources of nutrients, paying particular attention to sodium. This research showed that the risk of overweight/obesity increases with age, in people who have follow weight control diets, in ex-smokers, married people and those who slept less than 8.5 hours per day, while the risk is lower in women, people who make sport and those with an University degree. It was also found that overweight people had higher sodium intake and urine excretion. Therefore, and having in mind that 88.2% of the subjects took more than 2 g/day of sodium (the maximum recommended), it is advised to lower the sodium intake not only from the health point of view but also as a probably strategy against obesity.

The study ALADINO (Estudio de Alimentación, Actividad física, Desarrollo Infantil y Obesidad- Study of the Diet, Physical Activity, Child Development and Obesity) (2010-2011) was focused on 7659 children (6-9 years) from 19 autonomous communities. We founded a higher percentage of overweight/obesity in boys than in girls, and a significant increase in the figures from the age of 7. Being overweight is more evident in offspring of parents with low educational level or low income, or if parents are smokers (especially when both parents smoke). The problem increases in those children who skip breakfast, have

FACTORES ASOCIADOS AL PADECIMIENTO DE OBESIDAD EN MUESTRAS REPRESENTATIVAS DE LA POBLACIÓN ESPAÑOLA

Resumen

Ante el espectacular incremento en la prevalencia de obesidad y dadas las graves consecuencias sanitarias y económicas que conlleva, la comunidad científica, los profesionales y organismos sanitarios están buscando las mejores estrategias para prevenir/combatir la tendencia.

Para tomar medidas el primer paso es conocer los factores asociados al padecimiento de obesidad, para planificar las medidas de intervención más adecuadas. El presente trabajo presenta resultados de investigaciones realizadas/coordinadas por nuestro equipo investigador, en los últimos 5 años y promovidas por la Agencia Española de Seguridad Alimentaria (AESAN), en los que se presta atención al padecimiento de sobrepeso/obesidad y a los factores asociados, analizando muestras representativas de la población española.

Por una parte, se presentan datos de 418 adultos (18-60 años) estudiados en 2009 en 15 provincias (30 puntos de muestreo) para analizar las "Fuentes alimentarias de nutrientes de la población española" (FANPE) con especial atención al sodio, esta investigación puso de relieve que el riesgo de padecer sobrepeso/obesidad incrementa con la edad, en las personas que han realizado dietas de control de peso, exfumadores, personas casadas y en aquellas que dormían menos de 8.5 horas diarias. Mientras que el riesgo es menor en mujeres, personas que realizan algún deporte y en aquellas con estudios universitarios. También se constató que las personas con exceso de peso tenían mayor ingesta y excreción de sodio por orina. Por ello, teniendo en cuenta que un 88,2% de los sujetos estudiados tomaba más de los 2 g/día de sodio (límite máximo aconsejado) se considera conveniente reducir la ingesta de sodio, desde el punto de vista sanitario y probablemente también como estrategia en la lucha contra la obesidad.

En población infantil los datos del Estudio de Alimentación, Actividad física, Desarrollo Infantil y Obesidad (ALADINO) (2010-2011) estudiando 7.659 niños (6-9 años) de 19 CCAA, ponen de relieve un mayor padecimiento de sobrepeso/obesidad en varones, con incremento notable del problema a partir de los 7 años. También se constata que el exceso de peso es más evidente en descendientes de padres con escaso nivel de estudios y/o bajos ingresos, entre niños que no desayunan, en aquellos que comen en casa en comparación con los que comen en el colegio, cuando las instalaciones deportivas están lejos del domicilio del niño, o cuando los escolares disponen de ordenador personal, videoconsola o TV en su habitación, cuando

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lunch at home (compared with having this meal at school), in those with sports facilities far from their home, those who have a personal computer, video game or TV in their room, or those who sleep less than 8 hours per day.

All these factors, either by themselves or because they influence eating habits and/or activity patterns, are associated with a higher risk of being overweight, so it must be monitored and modified in a more favourable direction, within the health policies of each country, as part of strategies to halt the rise in obesity condition.

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Key words: *Obesity. Overweight. Risk factors. Spanish children. Spanish adults.*

Abbreviations

FANPE: “*Fuentes alimentarias de nutrientes de la población española*”-Food Sources of Nutrients in Spanish Diet.

ALADINO: “*Alimentación, Actividad física, Desarrollo Infantil y Obesidad*” -Study of the Diet, Physical Activity, Child Development and Obesity.

AESAN: Spanish Agency for Food Safety and Nutrition.

BMI: Body mass index.

%BF: Percentage body fat.

NW: normal weight.

OW: Overweight.

OB: Obese.

WHO: World Health Organization.

25(OH)D: 25-hydroxyvitamin D.

Na: Sodium.

NS: Non smoking parents.

1S: One smoking parent.

2S: Both smoking parents.

Introduction

Given the dramatic increase in the prevalence of obesity^{1,2} and the serious health and economic consequences,³⁻⁶ scientists, health professionals and health agencies are looking for the best strategies to prevent/fight this trend.

In order to plan the most appropriate intervention measures the first step is to identify the associated factors of obesity. Obesity is a multifactorial disease result of an interaction between genetic and environmental factors.^{1,4,5,7} But the environmental factors are those that most contribute to explain the increase in obesity in recent years (up to 60-70%),¹ having in mind that the genetic basis of the population may not have changed so quickly.^{4,7,8}

Given the health impact of overweight,^{3,6} it is important to take measures to fight this problem. It is important to identify the associated factors with a higher risk of obesity in order to take some concrete steps that can be especially useful for a particular population groups.

duermen menos de 8 h/día o los padres son fumadores (especialmente si fuman ambos).

Todas estas influencias, por si mismas o por condicionar los hábitos alimentarios y/o pautas de actividad del individuo se asocian con un mayor riesgo de presentar exceso de peso, por lo que deben ser vigiladas y modificadas en una dirección más favorable, dentro de las políticas sanitarias de cada país, como parte de las estrategias encaminadas a frenar el incremento en el padecimiento de obesidad.

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Palabras clave: *Obesidad. Sobrepeso. Factores de riesgo. Niños españoles. Adultos españoles.*

Therefore, analyzing the prevalence of overweight (OW) and obesity (OB) and their associated factors, in representative samples of the Spanish population, is of great interest and the subject of this study.

Studies in adults (FANPE)

The FANPE study (“*Fuentes Alimentarias de Nutrientes en la Población Española*”) was driven by the Spanish Agency for Food Safety and Nutrition (AESAN) and performed in a representative sample of Spanish adults, with the aim of analyze the food sources of nutrients in the Spanish population, paying special attention to the food sources of sodium.⁹

A total of 418 adults aged 18 to 60 years (196 male and 222 female) volunteered to take part in this study. Participants were selected from 15 Spanish provinces in order to represent the Spanish population. Within each province, some participants were selected from the province capital and another sample from a semi-urban or urban village. In total, 30 town/villages were selected to be part in the study. Fieldwork was conducted between January and September 2009.

Food intake was determined using the 24 h recall method on two consecutive days.¹⁰ Participants were asked about the food consumed on the preceding day (where appropriate the brands of these foods were also recorded), and on the size of the servings consumed (approximate weights or household measures: cups, bowls, plates, etc.). In addition, they indicated whether these weights or sizes corresponded to raw or cooked food, with or without bone, with or without skin, etc. The energy and nutrient intakes were then calculated using food composition tables.¹¹ DIAL software (Alce Ingeniería, 2004) was used to process all data.¹² Sanitary and socioeconomic data were recorded and all subjects completed a questionnaire on their usual physical activity.¹³

Some anthropometric measures were taken: weight, height, skinfolds, and waist and hip circumferences. All data were collected following norms set out by the WHO.¹⁴ The body mass index was calculated (BMI = weight [kg]/height [m]²). Percentage body fat (%BF) was determined by electrical bioimpedance.¹⁵ Subjects

Table I
FANPE Study. Weight data of the study sample.
Differences regarding sex. (%)¹⁸

	Total n = 418	Men n = 196	Women n = 222
Normal weight (%)	52.2 (218)	39.8 (78)	63.1 (140)
Overweight (OW) (%)	34.2 (143)	43.9 (86)	25.7 (57)
Obesity (OB) (%)	13.6 (57)	16.7 (32)	11.3 (25)
Whit weight excess (OW + OB) (%)	47.8 (200)	60.3 (118)	37.0 (82)
Excess of body fat (%) [#]	70.2 (293)	73.7 (143)	67.1 (147)
Central obesity [†] (%)	22.2 (93)	18.6 (36)	25.3 (56)
Waist/height $\geq 0,5$ (%)	54.7 (227)	65.5 (127)	45.3 (100)

[#] > 20% in males and > 30% in females. ***p < 0,001. [†]Waist circumference ≥ 102 cm in males and ≥ 88 cm in females.

were classified following the WHO classification as normal weight (NW) (BMI < 25 kg/m²), overweight (OW) (BMI ≥ 25 kg/m² and BMI < 30 kg/m²) and obese (OB) (BMI ≥ 30 kg/m²).^{14,16} A 24-h urine sample was taken and volume, sodium, potassium and creatinine concentration were determined.¹⁷

Table I resumes anthropometric data. 34.2% and 13.6% of the subjects were OW and OB respectively. That means that 47.8% of the population have an excess of weight (including OW and OB).¹⁸ 22.2% of adults have central obesity (defined by waist circumference ≥ 102 cm in men and ≥ 88 cm in women), and 54.7% have a waist/height ratio ≥ 0.5 . Body composition data are more worrisome, since 70.2% of those studied have a fat excess¹⁸

The risk of OW/OB was higher with increasing age [OR = 5.96 (3.20-11.13), p = 0], in people who had

followed weight control diets in the past [OR = 3.28 (1.98- 5.43), P < 0.001], in former smokers [OR = 2.22 (1.23-4.00), p = 0.008], in married people [OR = 1.64 (1.02-2.64), p = 0.041] and in those who slept less 8.5 hours per day [OR = 1.62 (1.05-2.52), p = 0.030]⁷ (fig. 1).

Furthermore, the risk was lower in women [OR = 0.34 (0.22-0.51), p = 0], in people who practiced a sport [OR = 0.55 (0.35 to 0.85), p = 0.008], and those with a university degree [OR = 0.53 (0.28-1.02), p = 0.050]. There was no association between OW/OB and the place of residence (rural/urban), stress, pregnancy or the number of children⁷ (fig. 1).

When we considered dietary data, it has been observed that individuals with NW had higher intakes of calcium and dairy products compared with those with OW and OB.¹⁹ There was also an inverse correlation between calcium intake and waist circumference (r = -0.096), waist/height ratio (r = -0.105) and waist/hip ratio (r = -0.100)²⁰.

Previous studies have shown a relationship between vitamin D status and weight control²¹. In an intervention study in overweight women who were following a hypocaloric diet during 6 weeks, those with better vitamin D status (25-hydroxyvitamin D (25(OH)D) serum level ≥ 50 nmol/l) loosed more body fat (-1.7 (SD 1.8) kg) than those with lower serum levels (-0.5 (SD 0.8) kg) and with the same caloric restriction. Therefore, a better vitamin D status aided the loss of body fat over the experimental period (OR 0.462; CI 0.271, 0.785; P < 0.001). This study highlighted that women with a better vitamin D status respond more positively to hypocaloric diets and lose more body fat; and this was especially clear among the subjects who had a greater vitamin D supply during the experimental period.²¹

Assuming that all urinary sodium (Na) (168.0 (SD 78.6) mmol/d) comes from the diet, the mean dietary salt intake was 9.8 (SD 4.6) g/d, and 88.2% of the subjects had

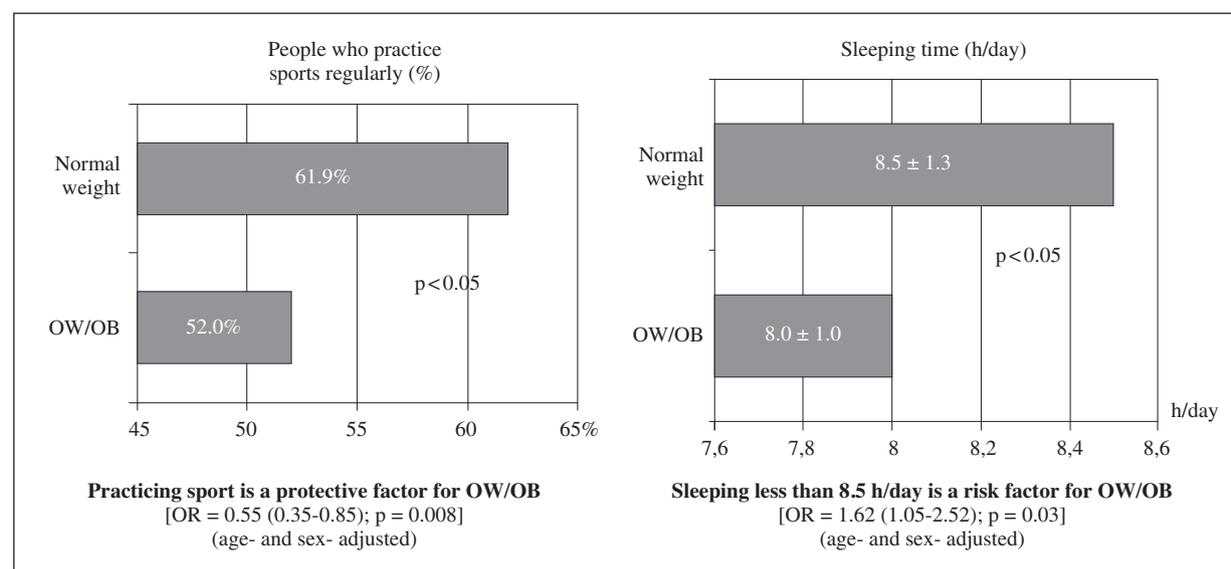


Fig. 1.—Associated factors of overweight/obesity (OW/OB) in Spanish adults.⁷ Rodríguez-Rodríguez et al. (2011).⁷

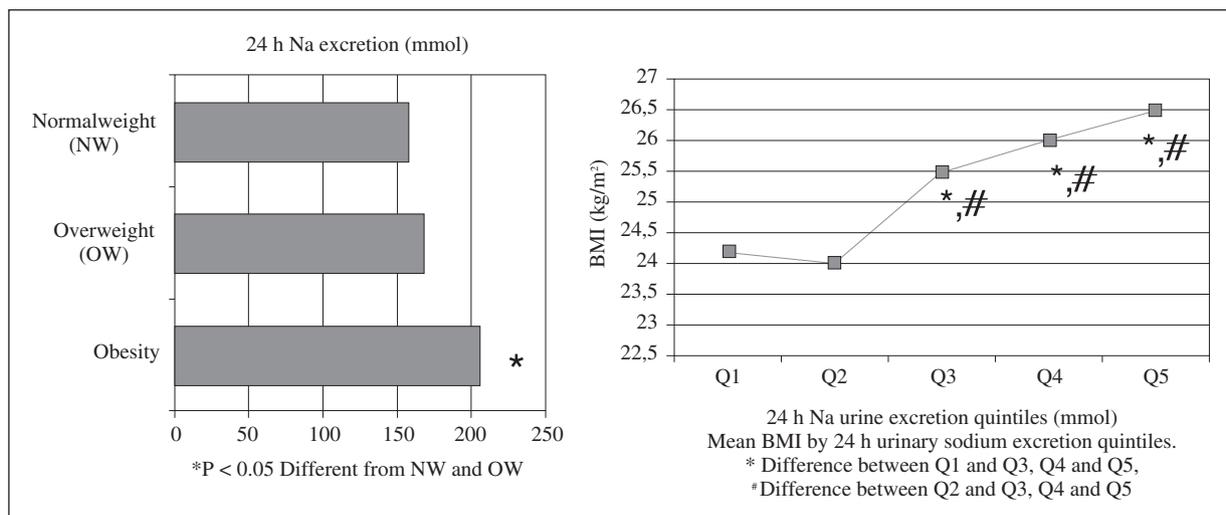


Fig. 2.—Relationship between sodium intake and Body Mass Index (BMI) in Spanish adults.¹⁶ Ortega et al. (2011).¹⁶

salt intakes above the recommended 5 g/day (85 mmol of Na/day).²² Logistic regression analysis, adjusted for sex, age and BMI, showed that being male (OR 3.678, 95% CI 2.336, 5.791) and increasing BMI (OR 1.069, 95% CI 1.009, 1.132) ($p < 0.001$) were associated with excreting > 200 mmol/d urinary Na. Na excretion was higher in those with overweight/obesity (179.8 (SD 81.9) mmol/d) compared with normal weight subjects (158.3 (SD 74.6) mmol/d) ($P < 0.001$) (fig. 2). Having in mind that the higher sodium intake is associated with higher BMI, the study highlights the importance of reducing Na intake, not only from the health point of view but also in the obesity control.¹⁶

Some of the observed associated factors of overweight/obesity can be easily modified: sleeping 8.5 h / day or more, being more active, avoiding an insufficient supply of some nutrients such as calcium and vitamin D and reducing the sodium intake. All of these are changes that can be helpful in weight management and the fight against overweight/obesity.

Studies in children (ALADINO)

ALADINO study was focused on anthropometric and obesity risk factors in childhood (ALADINO = Estudio de Alimentación, Actividad física, Desarrollo Infantil y Obesidad- Study of the Diet, Physical Activity, Child Development and Obesity). This was a cross-sectional study of Spanish schoolchildren performed under the auspices of the *Agencia Española de Seguridad Alimentaria y Nutrición* (AESAN; Spanish Agency for Food Safety and Nutrition). The study was conducted between October 2010 and May 2011²³ in 7659 children (3841 boys and 3818 girls) aged 6 to 9 years from 19 autonomous communities in 144 primary schools. Sample size and sampling points were established by AESAN in order to study a representative sample of Spanish schoolchildren.

ALADINO study was performed in the frame of the Childhood Obesity Surveillance Initiative (COSI) which is promoted by the European Office of the WHO. 17 member states participate in COSI and collect data from children aged 6-9 years using the same methodology and questionnaires.²⁴ Three questionnaires were originally designed by OMS in English and then translated and adapted to the Spanish population. The first was designed to record the child anthropometric data and completed by trained interviewers. The second one was filled out by parents and designed for recording dietary habits, activity patterns, and sanitary and socioeconomic data. The third one was filled out by the principal of each school who recorded information about school environment.

Each child's body weight and height were recorded, and then BMI was calculated as weight (kg)/height² (m²). All anthropometric measurements were made at the schools in the morning and following norms set out by the World Health Organization¹⁴. In the present paper we present the prevalence of overweight and obesity by sex and age group using the reference tables for Spanish children²⁵. Overweight and obesity are defined by the 85th and 97th percentiles respectively (table II).

The study ALADINO showed a higher percentage of overweight/obesity in boys, and a significant increase in this problem from the age of 7 (table II). It was also found that being overweight was more evident in offspring of parents with lower educational level or lower income. For NW children, 58.5% of mothers and 59.4% of fathers had a university degree, while in the OB group only 14.6% and 14.7% of mothers and fathers respectively reached the same educational level.

Being OW/OB was more frequent in children who skipped breakfast (table III). Other studies have found that the higher breakfast quality the higher quality of the whole diet and the better weight control^{26,27}. The problem is great in those children who have lunch at home (compared with having this meal at school), and in those with sports facilities far from their home (table III).

Table II
Prevalence of overweight¹ and obesity² in Spanish children, by sex and age (ALADINO Study)

	Total	Boys	Girls
Total (n)	7659	3841	3818
Overweight (%)	14.0	14.1	13.8
Obesity (%)	16.8	19.3	14.2*
With weight excess (%)	30.8	33.4	28.0*
6 years (n)	1822	902	920
Overweight (%)	11.1	10.5	11.7
Obesity (%)	11.5	14	8.9*
With weight excess (%)	22.6	24.5	20.6
7 years (n)	2204	1106	1098
Overweight (%)	13.2	12.1	14.3
Obesity (%)	15.8	18.7	12.8*
With weight excess (%)	29.0	30.8	27.1*
8 years (n)	2126	1081	1045
Overweight (%)	14.9	15.8	14.0
Obesity (%)	18.0	20.2	15.6*
With weight excess (%)	32.9	36.0	29.6*
9 years (n)	1507	752	755
Overweight (%)	16.5	17.6	15.2*
Obesity (%)	21.5	23.6	19.2*
With weight excess (%)	38.0	41.2	34.4*

¹Overweight was defined as BMI \geq P85 and $<$ P97. ²Obesity was defined by BMI \geq P97. * $p < 0.05$ Significant differences regarding sex.

Sleep duration (reported by parents) was also related to weight control in ALADINO study. NW children slept more hours (9.92 ± 0.70 h/day) than OW (9.84 ± 0.70 h/day) and OB children (9.76 ± 0.78 h/day) (differences significant among all groups). Sleep duration was

negatively correlated with weight ($r = -0.179$, $p < 0.001$), BMI ($r = -0.130$, $p < 0.001$) and waist circumference ($r = -0.139$, $p < 0.001$). Children who slept less than 8 h/day were more likely to be overweight (OR = 1.67, CI = 1.09-2.55) and to be obese (OR = 2.26, CI = 1.59-3.20), comparing with those who slept more than 10 h/day²⁸ (fig. 3).

Parents were also questioned about their smoking habits. 54.7% of children were offspring of non smoking parents (NS), while 29.8% of children had one smoking parent (1S) and 15.6% had both smoking parents (2S). 2S children had higher BMI (18.3 ± 3.3 kg/m²) than NS children (17.8 ± 2.8 kg/m², $p < 0.05$). 16.4% NS children were obese versus 19.2% in 1S group and 22.8% in 2S ($p < 0.05$ in all cases). These figures highlight that the smoking habits of parents are associated with the prevalence of obesity in their offspring. This could be explained by the worst dietary habits and lifestyle of the offspring of smokers, especially when both parents were smokers. NS children declared a higher consumption of fruits, vegetables, cheeses, eggs, breakfast cereals and bread, and lower of legumes, soft drinks, milkshakes, snacks, sweets, pastries and ready-to-eat and fast-foods than children with at least one smoking parent ($p < 0.05$ in all cases). A higher percentage of NS children participated in extracurricular sports activities, and spent less time watching television. It is probably that smokers were less concerned about health and nutrition issues, so they could be adversely influencing on the health of their offspring²⁹.

The dietary habits of the studied children were found far from those ideal, but more so in those children with overweight/obesity, who declared a lower consumption of vegetables, whole milk, meat, fish, sweets and pastries, white bread, pasta and breakfast cereals, and consumed more often diet soda, low fat or skim milk, and bread. No associations were observed between the

Table III
Dietary and lifestyle habits in Spanish children (ALADINO Study). Differences regarding weight

	Normal weight	Overweight	Obese
¿Did you have breakfast this morning? (Answered by children):			
- Yes (%)	96.9	97.0	95.8
- No (%)	3.1	3.0	4.2
Weekly breakfast frequency (answered by family):			
- All / almost all days of the week (%)	97.7	97.2	96.5*
- Never /less than 3 days/week (%)	2.3	2.8	3.5*
Where do the children usually have lunch Turing labouring days? (answered by family):			
- At home (%):	52.1	57.6*	59.5*
- At school (%):	47.9	42.4*	40.5*
Distance between home and sport facilities (answered by family):			
-Less than 1 km (%)	64.8	64.3	60.2*
-More than 1 km (%)	35.2	35.7	39.8*

* $p < 0.05$ regarding normal weight.

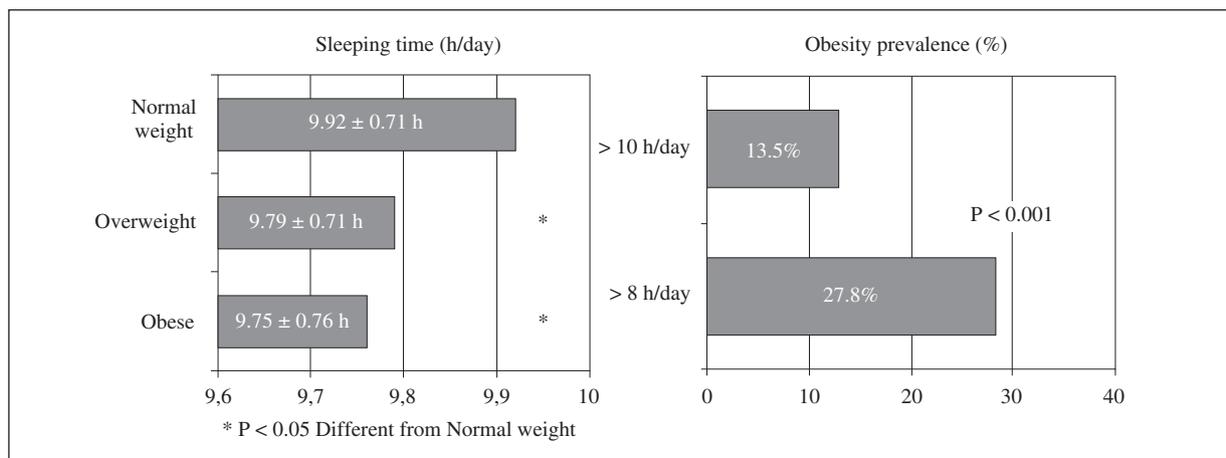


Fig. 3.—Sleeping time in Spanish children. Differences regarding weight status.²⁸ Villalobos et al (2013).²⁸

consumption of fresh fruit and natural fruit juices, vegetables, sugared soft drinks, milkshakes, eggs, cheese, yogurt, snacks or fast food and being overweight/obese.³⁰

Other studies have shown associations with different factors. For example, Kipping et al.⁵ suggest that modifiable risk factors for childhood obesity are maternal gestational diabetes, high levels of television viewing, low levels of physical activity; parents' inactivity, and high consumption of dietary fat, carbohydrate, and sweetened drinks. Some of these relationships are consistent with those observed in our Spanish population, while other aspects are different.

The results observed in our research on representative samples of the Spanish population in recent years highlight the high prevalence of overweight/obesity in both adult and children, and also point to several factors associated with the problem, which may be subject to future interventions.

The factors that favour obesity in particular populations should be analyzed and monitored in the future, in order to take specific measures and modify them in a more favourable direction.

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