Public Health Nutrition: 12(7), 1015–1018 doi:10.1017/S1368980008003571

Trends in excess weight and thinness among Spanish schoolchildren in the period 1992–2004: the Cuenca study

Vicente Martínez-Vizcaíno[1,*], Mairena Sánchez López[1], Pablo Moya Martínez[1], Montserrat Solera Martinez[1], Blanca Notario Pacheco[1], Fernando Salcedo Aguilar[2] and Fernando Rodríguez-Artalejo[3,4]

[1]Health and Social Research Center, Universidad de Castilla-La Mancha, Santa Teresa Jornet s/n, 16071 Cuenca, Spain: [2]Family and Community Medicine Teaching Unit, Castilla-La Mancha Health Service, Cuenca, Spain: [3]Department of Preventive Medicine and Public Health, Faculty of Medicine, Universidad Autónoma de Madrid, Madrid, Spain: [4]CIBER de Epidemiología y Salud Pública (CIBERESP), Spain

Submitted 6 November 2007: Accepted 19 May 2008: First published online 27 August 2008

Abstract

Background: In developed countries, there is abundant information on the epidemic of childhood obesity, but only a few studies on trends in the dual burden of body weight (overweight and thinness).

Objective: To examine trends in overweight and thinness among 9–10-year-old Spanish children in the last decade.

Methods: Data were taken from cross-sectional studies on schoolchildren in Cuenca (Spain), conducted in 1992, 1996, 1998 and 2004 with similar methods. Weight and height were measured by trained personnel with standardized procedures. Overweight (including obesity) and thinness were defined according with the International Obesity Taskforce BMI cut-offs.

Results: The overall prevalence of overweight increased from 24·4% in 1992 to 30·9% in 2004 ($P = 0·07$), rising from 21·2% in 1992 to 32·0% in 2004 ($P = 0·03$) among boys and from 27·7% to 29·8% ($P = 0·67$) among girls. The overall prevalence of thinness was 2·7% in 1992 and 9·2% in 2004 ($P < 0·001$); in the same period, thinness prevalence rose from 1·9% to 9·0% ($P = 0·10$) among boys and from 3·7% to 9·5% ($P < 0·01$) among girls.

Conclusions: The dual burden of body weight has increased among children in Cuenca in the last decade. Population-based policies addressing childhood obesity, which is the most frequent problem, should not increase the risk of thinness.

Keywords
Excess weight
Thinness
Dual burden
Schoolchildren
Spain

Overweight and thinness frequently coexist. This phenomenon, termed the dual burden of body weight[1], occurs even within a single family, and is especially frequent in countries in nutritional transition[2]. However, it is also observed in developed countries such as the USA, where one overweight and one underweight person are simultaneously found in 7·9% of households[1]. The dual burden of body weight is of public health importance, because policies targeted at controlling obesity may have undesirable effects on the thinnest individuals.

There is abundant information on the childhood obesity epidemic[3], but in developed countries trends in overweight and thinness among children are very seldom described jointly[4]. To our knowledge, the present study is the first on schoolchildren in a Mediterranean country which simultaneously examines the trends in overweight and thinness in the last decade.

Methods

Study design and population

The methodology of the study has been described elsewhere[5]. In 2004, a cross-sectional study was conducted among 1280 children attending the 4th and 5th grades at twenty-two public schools in the Province of Cuenca. Of these twenty-two schools, nineteen belonged to each of the most populated towns in the province and three were situated in the City of Cuenca. In 1992, 1996 and 1998, similar cross-sectional studies were conducted although only at schools in the City of Cuenca. The schools studied in 1992, 1996 and 1998 were also included in the 2004 study.

The four cross-sectional studies were authorized by the Cuenca Primary Health Care Research Committee. Also, the 2004 study was formally approved by the Clinical

*Corresponding author: Email Vicente.Martinez@uclm.es

Research Ethics Committee of the 'Virgen de la Luz' Hospital in Cuenca.

Ethical and legal aspects

The study was approved by the Director and Board of Governors (Consejo Escolar) of each school. In addition, the parents gave written consent to the participation of their children in the study. Informative talks were then held class-by-class, where the schoolchildren were asked to collaborate. After the data were obtained, the parents were informed by letter of their children's results.

Study variables

In the four cross-sectional studies, the anthropometric measurements were obtained at the schools by trained and certified nurses. Weight was measured with subjects lightly dressed and in stockinged feet, taking the mean of two measurements using a digital scale with an accuracy of 100 g. Height was obtained as the mean of two determinations with a wall-mounted height rod, with children in stockinged feet, standing straight against the wall so that their spine was vertically aligned with the centre of the height rod. The head was placed with the chin parallel to the floor, and height was measured to the nearest millimetre. BMI was calculated as weight in kilograms divided by the square of the height in metres (kg/m^2).

Statistical analysis

The following three criteria were used to classify the children as thin, overweight (including obesity) and obese: (i) the reference for BMI from the first National Health and Nutrition Examination Survey (NHANES I)[6], which defines thinness, overweight and obesity according to the 5th, 85th and 95th sex- and age-specific percentiles, respectively; (ii) the International Obesity Taskforce (IOTF) criteria[7,8], which provide sex- and age-specific BMI cut-offs based on percentiles passing at age 18 years through BMI 18·5 kg/m^2 for thinness, BMI 25 kg/m^2 for overweight and BMI 30 kg/m^2 for obesity; and (iii) the Centers for Disease Control and Prevention (CDC) growth charts for BMI[9], which also define thinness, overweight and obesity based on 5th, 85th and 95th percentiles, respectively. Confidence intervals for frequencies of each BMI category were calculated using the Newcombe–Wilson method[10].

Gender comparisons of the frequency of each BMI category were performed with the Mantel-Haenszel χ^2 test. Also, overall frequencies of each category of BMI were standardized by age and sex, using the direct method and the Spanish population aged 9 to 10 years in the 2000 census as standard. Finally, to examine the trend in BMI categories from 1992 to 2004, the χ^2 test for trend was used. Statistical significance was set at $P \leq 0{\cdot}05$ (two-tailed). Analyses were performed with the SPSS for Windows version 15·0 (SPSS Inc., Chicago, IL, USA) and StatsDirect version 2·3·8 (StatsDirect Ltd, Cheshire, UK) statistical software packages.

Results

Of the 1456 schoolchildren aged 9 to 10 years invited in 2004, 1166 (80·1%) participated in the study. Of these, 609 (52·2%) were girls and 557 (47·8%) boys. No statistically significant differences in age were observed between the two sexes. In the 1992, 1996 and 1998 studies, 271 (acceptance rate 88·7%), 233 (83·6%) and 249 (84·5%) schoolchildren participated, respectively. The proportion of boys and girls in each study was approximately 50%.

Table 1 shows the prevalence of BMI categories (overweight, normal weight and thinness) among schoolchildren in the Province of Cuenca in 2004. Overall prevalence of overweight varied from 30·8% with the IOTF criterion to 32·9% with the NHANES I criterion, and was slightly higher in boys than in girls in all three reference criteria. In general, frequency of overweight was higher with the NHANES I and CDC than with the IOTF criteria, although the differences were small. The overall prevalence of thinness varied from 4·4% with the CDC criterion to 9·3% with the IOTF criterion. Furthermore, it was greater among children aged 9 years than among those aged 10 years, and in boys aged 9 years and girls aged 10 years. The highest prevalence of thinness was obtained using the IOTF criterion, which was approximately double that obtained with NHANES I and CDC criteria.

Figure 1 depicts the trend in BMI categories over the period 1992–2004. The overall prevalence of overweight went from 24·4% in 1992 to 30·9% in 2004 ($P = 0{\cdot}07$), increasing from 21·2% in 1992 to 32·0% in 2004 ($P = 0{\cdot}03$) among boys and from 27·7% to 29·8% ($P = 0{\cdot}67$) among girls. The overall prevalence of thinness was 2·7% in 1992 and 9·2% in 2004 ($P < 0{\cdot}001$); in the same period, thinness prevalence went from 1·9% to 9·0% ($P = 0{\cdot}10$) among boys and from 3·7% to 9·5% ($P < 0{\cdot}01$) among girls. In 2004, the prevalence of overweight at the three schools in the City of Cuenca where the previous studies had been conducted was 33·7% in boys and 23·4% in girls; prevalence of thinness was 8·1% in boys and 10·3% in girls.

Discussion

Our study shows that the prevalence of overweight among schoolchildren in the Province of Cuenca is very high, and has risen substantially in boys in recent years. The prevalence of thinness increased in both sexes during the last decade.

Overweight prevalence in Cuenca schoolchildren in 2004 (30·8%) ranked among the highest worldwide. Such prevalence is similar to that found in Greece (31%) and Italy (36%), higher than in France (19%) and Germany (16%), and even higher than in Central and Northern European countries, such as Denmark (15%)[3]. It is also

https://doi.org/10.1017/S1368980008003571 Published online by Cambridge University Press

Table 1 Frequency (percentage and 95 % confidence interval) of overweight, normal weight and thinness among 9–10-years-old boys and girls from Cuenca, Spain, in 2004, according to different criteria

	9-year-olds					10-year-olds					Total population				
	Girls (*n* 317)		Boys (*n* 275)			Girls (*n* 292)		Boys (*n* 282)			Girls (*n* 609)		Boys (*n* 557)		
	%	95 % CI	%	95 % CI	*P*	%	95 % CI	%	95 % CI	*P*	%	95 % CI	%	95 % CI	*P*
Overweight															
NHANES I	29·7	24·6, 35·0	35·6	30·0, 41·6	0·14	31·8	26·5, 37·5	35·1	29·5, 41·0	0·46	30·7	27·1, 34·5	35·4	31·4, 39·5	0·10
IOTF	28·4	23·5, 33·7	31·3	25·8, 37·1	0·50	31·2	25·9, 36·8	32·6	27·2, 38·4	0·77	29·7	26·1, 33·5	32·0	28·1, 36·0	0·44
CDC	27·1	22·3, 32·3	34·9	29·3, 40·9	0·05	29·8	24·6, 35·4	34·4	28·9, 40·3	0·27	28·4	24·8, 32·2	34·7	30·7, 38·8	0·02
Normal weight															
NHANES I	64·7	59·1, 69·9	58·2	52·1, 64·0	0·12	64·0	58·2, 69·5	62·8	56·8, 68·4	0·82	64·4	60·4, 68·2	60·5	56·3, 64·6	0·19
IOTF	61·8	56·2, 67·2	58·2	52·1, 64·0	0·41	59·6	53·7, 65·3	59·9	53·9, 65·7	0·99	60·8	56·7, 64·6	59·1	54·8, 63·2	0·60
CDC	68·5	63·0, 73·5	58·2	52·1, 64·0	0·01	66·1	60·3, 71·5	63·5	57·6, 69·1	0·57	67·3	63·4, 71·0	60·9	56·7, 64·9	0·02
Thinness															
NHANES I	5·7	3·3, 8·8	6·2	3·6, 9·7	0·93	4·1	2·1, 7·1	2·1	0·8, 4·6	0·26	4·9	3·3, 6·9	4·1	2·6, 6·1	0·61
IOTF	9·8	6·7, 13·6	10·5	7·2, 14·8	0·86	9·2	6·2, 13·2	7·4	4·7, 11·1	0·53	9·5	7·3, 12·1	9·0	6·7, 11·6	0·82
CDC	4·4	2·4, 7·3	6·9	4·2, 10·6	0·25	4·1	2·1, 7·1	2·1	0·8, 4·6	0·26	4·3	2·8, 6·2	4·5	2·9, 6·5	0·97

NHANES I, reference for BMI from the first National Health and Nutrition Examination Survey[6], which defines thinness, overweight and obesity according to the 5th, 85th and 95th sex- and age-specific percentiles, respectively; IOTF, International Obesity Taskforce criteria[7,8], which provide sex- and age-specific BMI cut-offs based on percentiles passing at age 18 years through BMI 18·5 kg/m^2 for thinness, BMI 25 kg/m^2 for overweight and BMI 30 kg/m^2 for obesity; CDC, Centers for Disease Control and Prevention growth charts for BMI[9], which also define thinness, overweight and obesity based on 5th, 85th and 95th percentiles, respectively.

in excess of the US figure (25·6 %)[3]. Regardless of the present level, however, the frequency of overweight has increased among children in most developed countries[3].

The frequency of thinness among Cuenca schoolchildren is lower than in countries in nutritional transition, such as Brazil or China[4], similar to that in the USA[4], France[11] and Poland[12], and far lower than in developing countries[13], although the rates are inevitably based on different definitions of thinness. Forecasts for developed countries as a whole over the period 1990–2015 predict a decline in the frequency of thinness[11], probably due to a shift to the right of the entire distribution of BMI associated with the obesity epidemic. However, there are differences between countries. Whereas the frequency of thinness during childhood has been observed to decline in the USA[4], it has risen in recent decades in Russia[4] and there is also indirect evidence of an increase in France[11]. Indeed, we also observed this phenomenon in our study. While our results do not inform on the causes of the increase in thinness, we can speculate that this might be due to earlier sexual maturation[14], greater participation in sports, and keener concern about controlling body weight in children.

As in previous studies[4,11,15], only small differences were observed in the frequency of overweight when the three reference criteria were used. Again as in another study[11], the NHANES I and CDC criteria yielded similar prevalences of thinness. The IOTF criteria, however, provided a frequency of thinness that was approximately double that of the US criteria. Given that the IOTF thinness criteria were published very recently, we found no other study which used them. The different results on thinness obtained with the IOTF criteria are probably due to differences in the date of data collection, the characteristics of the countries of origin of the data, the design of the criteria, and the smoothing techniques used in the US criteria. Had we used the grade 2 cut-offs (linked to BMI 17 kg/m^2) of the IOTF criteria, the prevalence of thinness would have been lower. However, the low number of cases of thinness according to grades 2 and 3 of the IOTF criteria (only one child in 1992 and fifteen children in 2004) precluded a meaningful analyses with these cut-offs.

A correct interpretation of our results requires some methodological comments. Because we only studied children aged 9–10 years in Cuenca, extrapolation of the results to other age and geographic settings should be done with caution. It is of note, however, that our analyses are based on data which are comparable over time in terms of population representativeness and measurement techniques, and are unique in Spain for examining trends in overweight and thinness among children. Furthermore, the prevalence of obesity in Cuenca is similar to that reported by other cross-sectional studies in different Spanish provinces whose data were collected at the same dates as ours[16].

In conclusion, the frequency of normal weight has declined among children in Cuenca in the last decade,

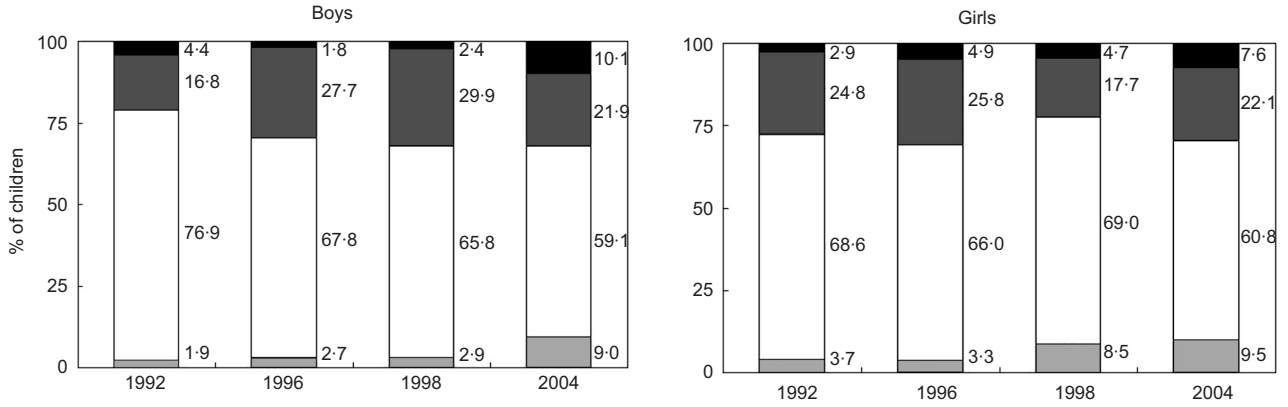

Fig. 1 Trends in age-standardized frequency of obesity (■), overweight (■), normal weight (□) and thinness (■) in 9–10-year-old boys and girls from Cuenca, Spain, from 1992 to 2004, according to the criteria of the International Obesity Taskforce (IOTF). Thinness includes grades 1, 2 and 3 because of the low number of cases of thinness according to grade 2 and 3 IOTF cut-offs (only one child in 1992 and fifteen children in 2004)

while the dual burden of body weight (overweight and thinness) has risen. Population-based policies addressing childhood obesity, which is the most frequent problem, should not increase the risk of thinness.

Acknowledgements

We thank the schools, families and children for their enthusiastic participation in the study.

The study was funded mainly by La Consejería de Sanidad de Castilla-La Mancha (grant GC03060-00). Additional funding was obtained from the Ministerio de Sanidad y Consumo, Instituto de Salud Carlos III, Red de Investigación en Actividades Preventivas y de Promoción de Salud (grant RD06/0018/0038).

Conflicts of interest: none declared.

Contributors: V.M.-V. was the principal researcher. V.M.-V. and F.S.A. designed the study together with F.R.-A., who contributed to refine the study design. V.M.-V. and F.S.A. coordinated the data collection. M.S.L. and B.N.P. carried out the measurements in the schools. M.S.M. and P.M.M. performed the statistical analysis, and all authors contributed to interpretation of results. V.M.-V. and F.R.-A. drafted the manuscript, and all authors critically revised it for scientific content and approved the final version.

References

1. Doak CM, Adair LS, Bentley M, Monteiro C & Popkin BM (2005) The dual burden household and the nutrition transition paradox. *Int J Obes (Lond)* **29**, 129–136.
2. Florencio TM, Ferreira HS, de Franca AP, Cavalcante JC & Sawaya AL (2001) Obesity and undernutrition in a very-low-income population in the city of Maceio, northeastern Brazil. *Br J Nutr* **86**, 277–284.
3. Lobstein T, Baur L & Uauy R; IASO International Obesity Task Force (2004) Obesity in children and young people: a crisis in public health. *Obes Rev* **5**, Suppl. 1, S4–S104.
4. Wang Y, Monteiro C & Popkin BM (2002) Trends of obesity and underweight in older children and adolescents in the United States, Brazil, China, and Russia. *Am J Clin Nutr* **75**, 971–977.
5. Martínez Vizcaíno V, Salcedo Aguilar F, Franquelo Gutiérrez R, Torrijos Regidor R, Morant Sánchez A, Solera Martínez M & Rodríguez Artalejo F (2006) Prevalencia de obesidad y tendencia de los factores de riesgo cardiovascular en escolares desde 1992 a 2004: estudio de Cuenca. *Med Clin (Barc)* **126**, 681–685.
6. Must A, Dallal GE & Dietz WH (1991) Reference data for obesity: 85th and 95th percentiles of body mass index (wt/ht^2) and triceps skinfold thickness. *Am J Clin Nutr* **53**, 839–846.
7. Cole TJ, Bellizzi MC, Flegal KM & Dietz WH (2000) Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* **320**, 1240–1243.
8. Cole TJ, Flegal KM, Nicholls D & Jackson AA (2007) Body mass index cut offs to define thinness in children and adolescents: international survey. *BMJ* **335**, 194.
9. Kuczmarski RJ, Ogden CL, Guo SS, Grummer-Strawn LM, Flegal KM, Mei Z, Wei R, Curtin LR, Roche AF & Johnson CL (2002) 2000 CDC growth charts for the United States: methods and development. *Vital Health Stat 11* **246**, 1–190.
10. Newcombe R (1998) Two-sided confidence intervals for the single proportion: a comparative evaluation of seven methods. *Stat Med* **17**, 857–872.
11. Rolland-Cachera MF, Castetbon K, Arnault N, Bellisle F, Romano MC, Lehingue Y, Frelut ML & Hercberg S (2002) Body mass index in 7–9-y-old French children: frequency of obesity, overweight and thinness. *Int J Obes Relat Metab Disord* **26**, 1610–1616.
12. Matusik P, Malecka-Tendera E & Klimek K on behalf of Polish Childhood Obesity Study Group (2007) Nutritional state of Polish prepubertal children assessed by population-specific and international standards. *Acta Paediatr* **96**, 276–280.
13. de Onis M, Blössner M, Borghi E, Frongillo EA & Morris R (2004) Estimates of global prevalence of childhood underweight in 1990 and 2015. *JAMA* **291**, 2600–2606.
14. Cole TJ (2000) Secular trends in growth. *Proc Nutr Soc* **59**, 317–324.
15. Flegal KM, Ogden CL, Wei R, Kuczmarski RL & Johnson CL (2001) Prevalence of overweight in US children: comparison of US growth charts from the Centers for Disease Control and Prevention with other reference values for body mass index. *Am J Clin Nutr* **73**, 1086–1093.
16. Serra-Majem L, Aranceta Bartrina J, Pérez-Rodrigo C, Ribas-Barba L & Delgado-Rubio A (2006) Prevalence and determinants of obesity in Spanish children and young people. *Br J Nutr* **96**, Suppl. 1, S67–S72.