

Social, economic and demographic correlates of overweight and obesity in primary-school children: preliminary data from the Healthy Growth Study

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Abstract

Objective: To record the prevalence of overweight and obesity in urban primary-school children in relation to several socio-economic and demographic factors.

Design: Cross-sectional.

Setting/subjects: A representative sample of 729 schoolchildren (379 male and 350 female), aged 9–13 years, stratified by parental educational level, was examined in the urban region of Athens. Weight and height were measured using standard procedures. The International Obesity Task Force thresholds were used for the definition of overweight and obesity. Several socio-economic and demographic data and the child's 'popularity' score were also recorded with specifically designed standardized questionnaires.

Results: The prevalence of overweight and obesity was 29.6% and 11.1%, respectively. Annual family income of €12 000–20 000 (OR = 1.58), residence ownership (OR = 1.63) and the grandmother as the child's primary caregiver (OR = 1.38) were significantly associated with higher odds of childhood overweight and obesity. Non-Greek parental nationality (OR = 0.72) and higher 'popularity' scores of children (OR = 0.42) were significantly associated with lower odds of overweight and obesity. The grandmother as the child's primary caregiver and an annual family income of €12 000–20 000 remained significantly associated with childhood overweight and obesity after adding all significant correlates of childhood overweight and obesity observed at the bivariate level in a multivariate regression model (OR = 1.51 and 1.61, respectively).

Conclusions: Among family income, residence ownership, child's primary caregiver, parental nationality and popularity scores that were identified as significant correlates of childhood overweight and obesity at the bivariate level, lower family income and grandmother as the child's primary caregiver were the only factors that remained significantly associated with childhood overweight and obesity at a multivariate level.

Keywords
Body mass index
Overweight
Children
Socio-economic status

The prevalence of overweight and obesity among Greek children has increased over the past decades⁽¹⁾. The rates of childhood overweight and obesity in Greece are similar or slightly higher to those reported in other European countries^(2,3). As with adults⁽⁴⁾, the adoption of adverse obesogenic behaviours by children seem to have a socio-economic, demographic and cultural dimension^(5,6). Parental educational level, family income, ethnicity and the child's primary caregiver are some of the socio-economic and demographic factors that have been previously

suggested to modify children's energy balance behaviours (i.e. dietary and physical activity patterns), thus having either a negative or positive impact on childhood obesity^(6,7). More specifically, previous studies in Greece and other developed countries have reported that paternal and/or maternal educational level was inversely associated with childhood obesity^(8–10). Furthermore, several indices that reflect the family's socio-economic status, such as annual family income, house or car ownership, house size, etc. have also been reported to be inversely

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related to childhood obesity⁽¹¹⁾. Nationality has also been reported to exert a significant effect on childhood obesity, although the limited data available in the literature for European countries provide some contradictory findings on their exact association^(10,11).

Clearly, family and other social factors influence children's eating patterns that may subsequently influence the onset of obesity. As children comprise the adult population of tomorrow, recording and understanding the prevalence of obesity in young children and the social, economic and demographic factors related to the phenomenon can facilitate the development of effective public health intervention policies in counteracting obesity and its health consequences later in life. It is known that early prevention is more effective in managing the epidemic of obesity in comparison with treating obesity later in life⁽¹²⁾.

The aim of the present study was to record the prevalence of overweight and obesity among 9–13-year-old schoolchildren in the capital city of Athens, the largest urban area of Greece, in relation to several socio-economic and demographic characteristics of children and their families. To test our research hypothesis, the preliminary data from an urban sub-cohort of the 'Healthy Growth Study' were used in the present analyses.

Subjects and methods

Sampling

The 'Healthy Growth Study' is a cross-sectional study initiated in May 2007. Approval to conduct the study was granted by the Greek Ministry of National Education and the Ethics Committee of Harokopio University of Athens. The population under study comprised schoolchildren aged 9–13 years attending the fifth and sixth grades from primary schools located in municipalities within the wider region of Athens. The sampling of municipalities and schools in the present study was random, multi-stage and stratified by the parental educational level and the total population of pre-adolescent students, thus yielding a representative sample of primary-school children from the wider urban region of Athens. More specifically, the municipalities in the county of Attica were divided into three groups based on the average educational level of their adult population (25–65-year-olds) that was estimated from data provided by the National Statistical Service of Greece (Census 2001). This procedure yielded two parental education cut-off points that allowed us to categorize municipalities into three categories of different socio-economic levels (SEL), i.e. higher, medium and lower SEL. Consequently, based on data from the National Statistical Service of Greece, a certain number of municipalities, proportional to the size of their pre-adolescent population (9–14-year-olds), was randomly selected from each of these three SEL groups. Finally, an appropriate number of schools was randomly selected from each of these municipalities in

relation to the population of schoolchildren registered in the fifth and sixth grades in each municipality, based on data obtained from the Greek Ministry of Education.

Weight and height were measured in all pupils attending the fifth and sixth grades in the participating primary schools as part of a school-based health and nutrition education programme. Full medical examination (i.e. anthropometrics and body composition measurements, blood collection, clinical examination, etc.) and questionnaire data were obtained from a sub-group of pupils whose parents signed a relative consent form. More specifically, an extended letter explaining the aims of the present study and a consent form for conducting full measurements were provided to all parents or guardians having a child in these schools. Parents who responded positively had to sign the consent form and provide their contact details. Signed parental consent forms for full measurements were collected for 754 out of 1236 children (response rate: 61%). From the total number of positive responses, complete medical examination data became available for 729 children who will be reported as 'study subjects' throughout the paper. Regarding data on weight and height, these were obtained from 1201 children in total (i.e. 729 'study subjects' and 472 'weight and height participants').

Anthropometry

'Study subjects' and 'weight and height participants' from each primary school underwent an examination by two trained members of the research team. The protocol and equipment used for all measurements were the same for all regions. The physical examination included basic anthropometric measurements, i.e. weight and height. Body weight was recorded to the nearest 10 g using a Seca digital scale (Seca Alpha, Model 770, Hamburg, Germany) and with children standing without shoes in the minimum clothing possible. Height was measured to the nearest 0.1 cm using a commercial stadiometer (Leicester Height Measure, Invicta Plastics Ltd, Oadby, UK) with the participants not wearing shoes, their shoulders in a relaxed position, their arms hanging freely and their head aligned in the Frankfort plane⁽¹³⁾. Weight and height were converted to BMI using Quetelet's equation (weight (kg)/height² (m²)). The International Obesity Task Force (IOTF) cut-off points⁽¹⁴⁾ were used to categorize participants as 'underweight', 'normal weight', 'overweight' and 'obese'.

Socio-economic and demographic variables

Data on the socio-economic and demographic background of the families having at least one child participating in the study were collected from the parents (most preferably from the mother) during scheduled face-to-face interviews at the school site. For those parents not able to attend the meetings (approximately 5% of the total sample), data were collected via telephone interviews. All interviews were conducted by a research team of ten members who were rigorously trained to minimize interviewer's effect with

the use of a standardized questionnaire. More specifically, the data collected by parents included (i) demographic characteristics, such as parent's age, educational level (years of education), origin and nationality; (ii) economic characteristics, such as family mean annual income over the past 3 years (€/year), family residence ownership; (iii) social characteristics, such as family size, i.e. the number of family members living in the family residence; the primary caregiver(s) of the child, i.e. parents, grandparents, nanny or someone else; family type based on parental marital status, i.e. core families and single-parent families with parents who were not married, widowed or divorced. Furthermore, a 'popularity' score among classmates was developed for each child by asking all pupils in the same class, including 'weight and height participants', to name at least one of their three best friends in their class. All votes were then summed to create 'popularity' scores for all 'study subjects'. These scores were then adjusted for class size by dividing them by the total number of boys and girls attending the same class for male and female 'study subjects', respectively. The test-retest reliability of the 'popularity score' index was checked in a representative sub-sample of 100 pupils and was found to be quite high, reaching a rate of 94.8%.

Statistical analysis

Some of the independent variables used in the present analyses were continuous while others were categorical. Normality of the distribution of continuous variables was analysed using the Kolmogorov–Smirnov test. Normally distributed continuous variables were expressed as mean and SD, skewed variables were reported as median (25th and 75th interquartiles) and categorical variables were reported as frequencies (%). Associations between continuous and categorical variables were examined using Student's *t* test for normally distributed variables and the non-parametric Mann–Whitney *U* test for skewed variables, while the association among the categorical variables was assessed using the χ^2 test. In order to test the effect of the independent variables examined on being overweight and obese, univariate logistic regression analyses were conducted and crude OR with 95% CI were computed. Furthermore, adjusted OR and 95% CI were also estimated using multivariate logistic regression analysis, including all variables that were found to be

significantly ($P < 0.05$) associated with childhood overweight and obesity at a univariate level. Moreover, since the sample of the present study is based on a cluster design (all children in primary schools enrolled in the study), this was taken into account in multiple logistic regression analysis using the option 'robust cluster'. All reported *P* values were based on two-sided tests. The level of statistical significance was set at $P < 0.05$. The Statistical Package for Social Sciences statistical software package version 13.0 (SPSS Inc., Chicago, IL, USA) was used for all statistical analyses and the STATA statistical software package version 8 (STATA Corp., College Station, TX, USA) for testing the clustering effect of schools.

Results

Table 1 displays the prevalence of underweight, normal weight, overweight and obesity for all pupils (i.e. both 'study subjects' and 'weight and height participants') attending the fifth and sixth grades in the schools under study. Overall, the observed prevalence was 3.5% for underweight, 57.7% for normal weight, 27.9% for overweight and 10.9% for obesity. No significant differences were observed between 'study subjects' and 'weight and height participants' with respect to these prevalence rates ($P = 0.270$), thus reducing the chance of any potential bias deriving from non-participation in the full protocol of the present study. Table 1 also summarizes the differences in the prevalence of underweight, normal weight, overweight and obesity among male and female 'study subjects'. Specifically, the prevalence of obesity was found to be significantly higher in male than female subjects (15.1% *v.* 6.6%, $P < 0.001$). Although a higher prevalence of underweight (3.1% *v.* 1.4%) and normal weight (60.3% *v.* 53.9%) was observed in female than male subjects, this was not significantly differentiated between genders.

The socio-economic and demographic characteristics of the population of 'study subjects' are presented in Table 2. In summary, the mean age of children under study was 11.2 (SD 0.7) years. Approximately half of the children's population under study was living in medium SEL residential areas while their parents had a medium educational level (9–14 years). Nationality in the majority of subjects was

Table 1 Prevalence of overweight and obesity in study subjects and weight and height participants

Weight groups	Study subjects (<i>n</i> 729)						Weight and height participants (<i>n</i> 472)		All subjects (<i>n</i> 1201)	
	Male (<i>n</i> 379)		Female (<i>n</i> 350)		Total (<i>n</i> 729)		<i>n</i>	%	<i>n</i>	%
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%				
Underweight	7	1.8	16	4.6	23	3.2	19	4.0	42	3.5
Normal weight	201	53.0	208	59.4	409	56.1	284	60.2	693	57.7
Overweight	113	29.8	103	29.4	216	29.6	119	25.2	335	27.9
Obese	58	15.1	23	6.6*	81	11.1	50	10.6	131	10.9

* $P < 0.001$ for differences between genders derived from the χ^2 test.

Table 2 Socio-economic status and demographic characteristics of study subjects

	Study subjects (<i>n</i> 729)	
	<i>n</i>	%
Age (years)*	11.2	0.7
Popularity' score†	0.33	0.16–0.60
Family size (number of family members)	4.0	3.0–4.0
SES of residential area		
Lower	254	34.7
Medium	314	43.0
Higher	161	22.3
Annual family income (€/year)		
<12 000	200	27.6
12 000–20 000	211	28.9
20 000–30 000	159	21.8
>30 000	159	21.8
Fathers' age categories		
Lower tertile (<41 years old)	251	34.5
Medium tertile (41–46 years old)	270	37.0
Higher tertile (>46 years old)	208	28.5
Mothers' age categories		
Lower tertile (<37 years old)	300	41.2
Medium tertile (37–42 years old)	239	32.8
Higher tertile (>42 years old)	190	26.0
Paternal educational level		
Low (≤9 years of education)	158	21.7
Medium (>9 and ≤14 years of education)	353	48.4
High (>14 years of education)	218	29.9
Maternal educational level		
Low (≤9 years of education)	128	17.5
Medium (>9 and ≤14 years of education)	382	52.4
High (>14 years of education)	219	30.0
Parents' nationality		
Greeks	516	70.9
Non-Greeks	213	29.1
Residence ownership		
No	268	36.6
Yes	461	63.4
Child's primary caregiver		
Parents	448	61.5
Grandfather	47	6.4
Grandmother	192	26.3
Nanny/someone else	42	5.8
Parental marital status		
Core families – married parents	641	87.9
Single parent families – not married parents	16	2.2
Single parent families – widowed parent	14	1.9
Single parent families – divorced parents	58	7.9

SES, socio-economic status.

*Data are presented as mean and sd.

†Data are presented as median and 25th–75th percentiles.

Greek (70.9%). Furthermore, most children (63.4%) lived in residences owned by their families. The grandmother was the child's primary caregiver in almost 25% of our population. An analysis per gender revealed that parent's non-Greek nationality and residence ownership were higher for girls than boys (32.5% *v.* 26%, $P < 0.05$; 67.2% *v.* 59.7%, $P < 0.05$, respectively), whereas the grandmother as the child's primary caregiver was more frequent for girls rather than boys (28.8% *v.* 23.5%, $P < 0.05$), and the nanny or someone else appeared more frequently as the child's primary caregiver for boys than girls (8.3% *v.* 3.5%, $P < 0.05$).

Table 3 summarizes the crude OR and 95% CI for being overweight and obese also controlling for the clustering

effect of schools. An annual family income of €12 000–20 000 was related to an increased likelihood of childhood overweight and obesity (OR = 1.56; 95% CI 1.07, 2.35) compared to an annual family income of >€30 000. Furthermore, children whose residence was owned by their family were 1.68 times more likely (95% CI 1.22, 2.25) to be overweight and obese than children whose residence was not owned by their family. Moreover, in families in which the primary caregiver of the child was his/her grandmother, the risk of childhood overweight and obesity was 1.38 times higher (95% CI 1.03, 1.98) than families where the child's primary caregivers were his/her parents. In contrast, children whose parents' nationality was Greek were 1.38 times less likely (95% CI 1.03, 1.96) to be overweight and obese than children whose parents' nationality was non-Greek. Finally, for every 1° increase in the child's 'popularity' score, the likelihood of childhood overweight and obesity was found to decrease by 60% (95% CI 0.17, 0.97). Furthermore, Table 3 also presents the adjusted OR and 95% CI derived from the multivariate logistic regression analysis, including in the same model all variables that were found to be significantly related to childhood overweight and obesity ($P < 0.05$) at a univariate level. Based on the results derived from the present analysis, those variables that remained significantly associated with childhood overweight and obesity were the grandmother as the child's primary caregiver (OR = 1.53; 95% CI 1.05, 2.29) and annual family income of € 12 000–20 000 (OR = 1.61; 95% CI 1.03, 2.61), respectively.

Discussion

The findings of the present study revealed a high prevalence of both overweight and obesity in a population of primary-school children living in a large urban area of Greece. Using the international cut-off points recommended by the IOTF⁽¹⁴⁾ (Table 2), 29.6% of children were found to be overweight and 11.1% were found to be obese with the prevalence of obesity being significantly higher for boys than girls (15.1% *v.* 6.6%). Comparing the findings of the present study regarding the prevalence of overweight and obesity with those reported for other European countries⁽³⁾, there seems to be a geographic variation. Precisely, the prevalence reported from studies conducted with children living in southern European countries surrounding the Mediterranean, including the present study, ranged between 20% and 41% and was considerably higher than the prevalence reported for the northern areas in Europe that showed prevalence rates in the range of 10–20%⁽³⁾. Several potential explanations have been proposed for these North–South trends in the prevalence of childhood overweight in Europe including higher stature and resting energy expenditure for children living in northern latitudes and a genetic predisposition towards weight gain in children living in southern Europe⁽³⁾.

Table 3 Crude and adjusted OR and 95% CI for the association between overweight and obesity with several socio-economic and demographic factors in the study subjects (*n* 729)

	Overweight and obese				
	%	Crude		Adjusted	
		OR	95% CI	OR*	95% CI
Annual family income (€/year)					
>30 000	38.5	1.00	Ref.	1.00	Ref.
<12 000	33.9	0.81	0.54, 1.27	1.05	0.61, 1.86
12 000–20 000	49.7	1.56	1.07, 2.35	1.61	1.03, 2.61
20 000–30 000	41.0	1.06	0.70, 1.79	1.02	0.62, 1.67
Parents' nationality					
Non-Greek	35.8	1.00	Ref.	1.00	Ref.
Greek	44.1	1.38	1.03, 1.96	1.04	0.65, 1.68
Residence ownership					
No	34.4	1.00	Ref.	1.00	Ref.
Yes	46.7	1.68	1.22, 2.25	1.58	0.98, 2.20
Child's primary caregiver					
Parents	39.0	1.00	Ref.	1.00	Ref.
Grandfather	48.8	1.43	0.74, 2.85	1.66	0.83, 3.19
Grandmother	46.9	1.38	1.03, 1.98	1.53	1.05, 2.29
Nanny/someone else	45.9	1.34	0.67, 2.63	1.62	0.82, 3.10
'Popularity' score (adjusted for class participation by gender)	–	0.40	0.17, 0.97	1.09	0.65, 1.84
SES of residence region					
Lower	38.6	1.00	Ref.	–	–
Medium	42.8	1.15	0.81, 1.62	–	–
Higher	39.9	1.05	0.72, 1.58	–	–
Fathers' age categories					
Lower tertile (<41 years old)	43.6	1.00	Ref.	–	–
Medium tertile (41–46 years old)	37.9	0.80	0.57, 1.14	–	–
Higher tertile (>46 years old)	44.0	1.00	0.66, 1.48	–	–
Mothers' age categories					
Lower tertile (<38 years old)	44.4	1.00	Ref.	–	–
Medium tertile (38–42 years old)	40.1	0.83	0.57, 1.18	–	–
Higher tertile (>42 years old)	40.1	0.81	0.55, 1.22	–	–
Paternal educational level					
Low (≤ 9 years of education)	39.1	1.00	Ref.	–	–
Medium (>9 and ≤ 14 years of education)	45.5	1.26	0.78, 1.92	–	–
High (>14 years of education)	36.6	0.93	0.59, 1.46	–	–
Maternal educational level					
Low (≤ 9 years of education)	38.6	1.00	Ref.	–	–
Medium (>9 and ≤ 14 years of education)	42.7	1.17	0.74, 1.80	–	–
High (>14 years of education)	42.3	1.13	0.69, 1.85	–	–
Parental marital status					
Core families – married parents	41.6	1.00	Ref.	–	–
Single parent families – not married parents	53.3	1.50	0.52, 4.26	–	–
Single parent families – widowed parent	53.8	1.61	0.52, 4.91	–	–
Single parent families – divorced parents	42.3	1.05	0.58, 1.89	–	–
Family size (number of family members)	–	0.94	0.77, 1.11	–	–

Ref., referent category; SES, socio-economic status.

*All OR were adjusted for annual family income, parent's nationality, residence ownership, child's primary caregiver, popularity score, gender and for the clustering effect of schools.

Cells in bold indicate statistically significant OR.

Regarding Greece, the prevalence of overweight and obesity reported in the present study was comparable to the prevalence reported by other recent studies conducted in children of similar age living in urban and semi-urban areas from southern (29.8% overweight and 14.9% obesity)⁽¹⁾, northern (25.3% overweight and 5.6% obesity)⁽¹⁵⁾, western (34.3% overweight and 9.6% obesity)⁽¹⁶⁾ and eastern (30.3% overweight and 6.7% obesity)⁽¹⁾ parts of Greece. Similar to the present study, the prevalence of obesity was also found to be significantly higher in male than female subjects in almost all of the aforementioned studies. The IOTF cut-off points

were used for screening children's overweight and obesity in all of these studies.

Certain socio-economic and demographic factors that have been reported by previous studies as correlates of childhood overweight^(17,18) were also tested in the present study. A lower-medium annual family income of €12 000–20 000 was associated with an increased likelihood of childhood overweight and obesity compared to a higher annual family income level of € >30 000, both at the bivariate and multivariate levels. This finding is in line with those reported from other recent studies conducted in children in developed countries indicating that income,

which is probably the most accurate index of socio-economic status, is inversely related to the consumption of energy-dense foods, such as fats and sweets, full-fat meat, dairy products, etc.^(19–21). In contrast, children from relatively lower-income families tend to have a lower intake of vegetables, fruits and whole-grain products⁽¹⁹⁾. It has been reported that the energy density of foods and their energy cost are inversely related, which means that the more energy-dense diets represent the lowest-cost dietary options to the consumer^(22,23). Provided that higher socio-economic status is probably reflected by residence ownership, then the finding of the present study regarding the association of this other index of socio-economic status with childhood overweight contradicts that observed for income. The increased likelihood of overweight observed in children whose parents owned their house could probably be ascribed to the fact that many parents reported their residence as privately owned, although their house was bought with a housing bank loan. In this case, residence ownership should not be considered as an accurate index of higher socio-economic status since a substantial amount of the family's budget pays off the monthly instalments of the bank loan, probably having a direct impact on children's nutrition. Moreover, residence ownership may not be a representative index of socio-economic status, when used as a single index⁽²⁴⁾.

The significant positive association observed in the present study between residence ownership and childhood overweight and obesity could also be attributed to the mediating role of the parent's nationality. More specifically, our findings showed that Greek nationals were 9.1 times (OR = 9.09; 95% CI 6.18, 13.39) more likely to own their house and they were also 38% more likely to be overweight or obese than non-Greek nationals. The vast majority of non-Greek subjects, whose parents came to Greece as economic immigrants during the period of the economic and political transition in the 1990s, were from Albania (75.6%) and from other Eastern European countries (i.e. Russia, Ukraine, Poland, Serbia, etc.; 12.6%). In these countries, Lobstein and Frelut⁽³⁾ reported lower prevalence rates of childhood overweight in comparison to children living in the non-Eastern bloc European countries. The implication of this observation is that the lower prevalence of overweight also reported in the present study for non-Greek subjects, having mainly an Eastern European nationality, could be attributed to a genetic predisposition for lower BMI compared to Greek children. To our knowledge, no evidence exists on this topic, and therefore further research, including the study of certain genes and polymorphisms, is needed in order to shed more light on these differences.

Children's 'popularity' score was another index that was found to be inversely associated with childhood overweight when analysed at the bivariate level. A potential explanation for this finding might be the fact that children who are more athletic and of normal weight are usually more popular

among their peers. Previous studies have also confirmed the association observed in the present study between weight status and social acceptance in populations of pre-adolescents. Reynolds *et al.*⁽²⁵⁾ have reported that overweight was an index of less social acceptance in girls aged 9–14 years. Furthermore, Latner and Stunkard⁽²⁶⁾ have reported that overweight and obese (10–11 years old) children were significantly less popular than their normal-weight peers. According to previous studies, children before and during puberty are very much concerned about their weight and body image⁽²⁷⁾; thus, another way of explaining this association could be that children's 'popularity' concerns related to their body image may control the increase in their body weight.

Another important outcome of the regression analysis performed in the present study was that children whose primary caregiver was their grandmother had an increased likelihood of being overweight or obese both at the bivariate and multivariate levels. In a recent study, it was observed that food consumption in children was adjusted according to the stimuli induced by the food served by their caregivers or parents, instead of being regulated by the satiety and increased energy following the previously consumed meals⁽²⁸⁾. In most cases, grandparents tend to believe that overweight signifies healthiness⁽²⁹⁾ or that young children may grow out of being overweight⁽³⁰⁾. Another interpretation of this particular finding is probably based on the so-called 'post-World War II overfeeding syndrome'⁽³¹⁾ referring to the post-war period in Greece when there was severely decreased accessibility to food. Children's grandmothers, who most likely experienced hunger and extreme difficulties in finding food as children during those years, tend to overfeed their grandchildren with affluent portions of foods, as an expression of their care and insecurity. Furthermore, Gordon-Larsen *et al.*⁽⁷⁾, in a study of girls aged 6–9 years, observed that caregivers, including grandmothers, influenced their children in adopting a sedentary lifestyle, as they considered sedentary habits, such as television viewing, a more secure and easier way of having control of their children.

The present findings should be interpreted in the light of the limitations and strengths of the present study. Regarding the limitations, the cross-sectional design of the study does not allow the establishment of cause–effect relationships, but only generates hypotheses about the possible role of the social, economic and demographic factors examined in the present study on the development of overweight and obesity in children. Moreover, it should be noted that the present findings are the preliminary results of an ongoing study and thus should be interpreted with caution. However, the relatively large study sample and the random and multi-stage sampling of schools yielded in a representative sample of the wider region of Athens and this could be considered as a strength of the present study. Furthermore, the assessment of weight status in almost all children in the schools under study, combined with the

fact that we observed no significant differences in the prevalence of overweight and obesity between 'study subjects' and 'weight and height participants' can also be considered as the strengths of the present study, indicating that our findings are unbiased and controlled for the parameter of will or motivation for participation in the study and its consequent possible confounding effect.

In conclusion, the present study showed that the considerably high prevalence of overweight and obesity among urban primary-school children in Greece also seems to have a socio-economic and demographic dimension. More specifically, lower family income and grandmother as the child's primary caregiver were the main risk factors for being overweight and obese among primary-school children living in a large urban area in Greece. The conclusion of the present study has several implications for the prevention of childhood obesity. Appropriate interventions and population-based strategies are needed, targeting lower-income families and probably those families in which both parents are working and the grandmother acts as the child's primary caregiver.

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Conflicts of interest: The study sponsor had no role in the design of the study; the collection, analysis or interpretation of the data; the writing of the manuscript; and in the submission of the paper. None of the other authors had any personal/financial/potential conflict of interest. Y.M. worked as a part-time science and nutrition consultant for FrieslandCampina Hellas. *Authorship responsibilities:* Y.M. and G.M. were responsible for the study design and supervision of the field study. Y.M., G.M. and O.A. performed the statistical analyses and the interpretation of the data. All authors carried out the data collection and contributed to data management, to database preparation and to the writing and approval of the final version of the manuscript submitted for publication.

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