Prevalence and Determinants of Overweight/Obesity in Adolescents: A Cross-Sectional Study in Greece

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Abstract

Background: Prevalence of childhood obesity has increased remarkably turns into a big problem in developed world, affecting significantly the physical and the emotional health of children.

Objective: To estimate the overweight/obesity prevalence of children 10 to 15 years-old and to find out the determinants of this disease.

Methodology: We conducted a cross-sectional study on 306 children 10 to 15 years-old in elementary and intermediate schools in Larissa, Greece. Selection of schools was performed in a random way with the use of a table of random numbers and response rate was 86.9% (306 out of 352). Data collection was performed during May 2015 and the children were classified as underweight, normal, overweight and obese according to body mass index, gender and age. The determinants under study were demographic characteristics, internet use, personal computer use, television watching, nutritional habits, physical activity, sleeping habits and attitudes towards diet issues. Data analysis was performed with IBM SPSS 21.0

Results: Seventy-seven point five percent of the children were classified as normal, 12.1% as overweight, 10.1% as underweight and 0.3% as obese. In particular, 19.6% of the boys and 4.6% of the girls were overweight, while 0.6% of the girls and 0% of the boys were obese. Mean body mass index of children was 18.1kg/m^2. Multivariate logistic regression analysis identified that boys, children with television in their room and children who used personal computer/video games machines/mobile/tablet were more overweight/obese.

Conclusions: Appropriate health policies should be implemented in order to decrease obesity among children based on the determinants of this disease.

Keywords: body mass index, children, determinants, obesity, overweight, prevalence.

Introduction

Childhood obesity turns into a big problem in developed world, affecting significantly the physical and the emotional health of children. Also, morbidity and premature death in the adult life are higher among obese children.

Factors that affect children's weight and fat distribution include environmental and genetic characteristics since prevalence of overweight and obesity are different in populations with similar lifestyle.

Background

During the last 50 years, prevalence of childhood obesity has increased remarkably, especially in developed industrial areas (Lobstein, 2010; Wang & Lobstein, 2006; Wang & Zhang, 2006). In that case, prevalence of overweight and obesity among 5 to 17 years-old children is

21.4% for boys and 22.9% for girls (Organization for Economic Co-operation Development, 2011). Prevalence of overweight and obesity in children varies among countries of Organization for Economic Co-operation and Development (OECD), with the higher prevalence to be in Greece (40%) and the lower in Korea, Turkey and China (4.5 to 16%) (Organization for Economic Co-operation Development, 2011).

A recent systematic review find out that the childhood obesity in Greece is increasing during the last 30 years (Roditis et al, 2009). Studies in Greece found that prevalence of overweight and obesity in children is among 30 to 40% (Krassas et al, 2001; Magkos et al, 2006; Janssen et al, 2006; Papadimitriou et al, 2006). In 2011, a cross-sectional national study including 6 to 12 years-old children found that prevalence of obesity for boys was 31.2% and for girls 26.5% (Tzotzas et al, 2011).

There are a great number of papers and systematic literature reviews about the determinants of childhood obesity (Monasta et al, 2010; Mistry & Puthussery, 2015; Hebebrand & Hinney, 2008; Kipping et al, 2008). Concisely, determinants could be summarized as demographic characteristics, watching television, personal computers and internet use, eating habits, physical activity, sleeping habits, family attitudes and genetic factors.

Aim

The increasing prevalence of childhood obesity and the following problems in mature life of children and in the public health demand more studies in this scientific area in order to clarify the determinants of childhood obesity. For that reason, we conducted this study in order to estimate the prevalence of obesity in 10 to 15 years-old children and to found out the determinants of childhood obesity.

Methodology

Participants

We conducted a cross-sectional study in Larissa, Greece, during May 2015. Larissa is a high-density (7,733 residents per km^2) urban city surrounded by a network of suburbs and villages, with 146,926 residents at the time of study (National Greek Survey, 2011). Study was conducted in three elementary schools and one intermediate school. Selection of schools was performed in a random way with the use of a table of random numbers. All children attending the last two classes in the elementary schools and all classes in the intermediate school were invited to participate in the study. Response rate was 86.9% (306 out of 352).

Design

A pilot study with 30 children was conducted prior to the final study and face validity of the questionnaire was confirmed. In particular, children did not meet difficulties in the completion of questionnaire and they did not report any vaguenesses or errors in expression of questions.

Unfortunately, a great number of children (28 out of 30) denied to measure their weight and height on a standardized equipment by the researchers (bathroom scale and aluminum anthropometer), but all children accepted to self-estimate their weight and height.

So, in order to increase the response rate in the final study we decided to permit children to self-estimate their weight and height rather than to do these measurements on a standardized equipment.

Ethical considerations

First of all, we informed children and their parents (or their guardians) oral and written about the study and after a week we invited children to complete voluntary an anonymous, self-reported questionnaire. Children and their parents were assured of the anonymity and strict confidentiality of their responses and that children could withdraw from the study any time.

Also, we informed children that the questionnaire was not an examination and that there were no right or wrong answers. In that way, we assured the informed consent of students in our study. With the assistance of teachers, we distributed the questionnaires to the children during classroom hours. The questionnaires were returned in sealed envelopes to ensure confidentiality, while the questionnaires and the envelopes did not require any means of identification. The study protocol was approved by the Greek Ministry of Education, Research and Religion and in particular by the Institute of Educational Policy that is responsible for studies conducting in children.

Outcome

As mentioned above, we decided to permit children to self-estimate their weight and height in order to increase the response rate in our study. Then, we calculated body mass index (BMI) by dividing body weight (kg) by height squared (m^2) and we used a World Health Organization expert committee recommendations (World Health Organization, 1995) in order to categorize children into underweight (BMI< 5th percentile), normal weight (5th percentile ≤ BMI < 85th percentile), overweight (85th percentile ≤ BMI < 95th percentile), and obese (≥ 95th percentile).

Determinants

Determinants under study include demographic characteristics, watching television, personal computer and internet use, physical activity, dietary habits, sleeping habits and attitudes with regards to dietary issues. We conducted a systematic literature review in order to find the determinants under study. We performed this review on PubMed using the following keywords: adolescent(s), child(ren), kid(s), girl(s), boy(s), adolescence, school, determinant(s), risk factor(s), exposure(s), characteristic(s), body mass index, BMI, obesity, weight, obese, body weight, body, overweight.

Review included papers that have published in English until September 2014. Demographic characteristics included children's sex and age, mothers' age, nationality, educational level and occupation of mother and father and owning a house and a car. Also, we investigated hours of watching television/DVD's, television in children's room, hours of personal computer/video games machine/mobile/tablet use and hours of internet use.

Physical activity characteristics included participation in activities outside school (football, basketball, volleyball, swim, dance, toe dance etc.), bicycling, mode of transport to the school (on foot, by a car or a bus) and dog walking.

Dietary habits included junk food, breakfast and lunch with parents and soft drinks consumption, while sleeping habits included duration of night sleep.

Finally, attitudes with regards to dietary issues included existence of a family member on a diet during the last year, existence of a family member with an eating disorder (anorexia nervosa or bulimia nervosa) and conversation with family and friends about dietary issues.

Data analysis

Categorical variables are presented as number (percentage), while continuous variables as mean (standard deviation). The Kolmogorov-Smirnov test and graphs (histograms and normal Q-Q plots) were used to test the normality of the distribution of the continuous variables. Body mass index, children's and mothers' age and duration of night sleep followed normal distribution, while the other continuous variables did not follow normal distribution.

Children were categorized into those with BMI within normal range (children with normal BMI) and those who were above normal BMI values (overweight and obese children). Differences between groups were evaluated using chi-square test and chi-square trend test for categorical variables and independent samples t-test for continuous variables following normal distribution or the Mann-Whitney U-test for those not following normal distribution.

Logistic regression analysis was used to examine the predictive factors that influence children's BMI (children with normal BMI or overweight/obese children). First, bivariate analyses of each potential predictive factor was performed and those factors with an independent significant association (p-value<0.20) were included in a multivariate logistic regression analysis.

A backward stepwise elimination method was used for model development in a multivariate logistic regression model. Multivariate analysis was applied in order to eliminate potentially confounding. In multivariate logistic regression model, we present the adjusted odds ratios with 95% confidence intervals. Only variables with 95% confidence interval for adjusted odds ratio that did not cross 1 were considered to have an independent and significant association with children's BMI. A two-sided p-value of less than 0.05 was considered statistically significant. Statistical analysis was performed using the Statistical Package for Social Sciences software (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.).

Table 1. Demographic characteristics of the children.

Characteristic	N (%)
Sex	
Girls	153 (50.0)
Boys	153 (50.0)
Children's age	12.7 (1.70)†
Mothers' age	42.1 (4.7)†
Children's height (m)	1.60 (0.12)†
Children's weight (kg)	47.9 (12.3)†
Body mass index (kg/m^2)	18.5 (2.9)†
Classification of children according to body mass index	
Underweight	31 (10.1)
Normal	237 (77.5)
Overweight	37 (12.1)
Obese	1 (0.3)
Mothers' origin	
Greece	288 (94.1)
Other	18 (5.8)
Fathers' origin	
Greece	294 (96.1)
Other	11 (3.6)
Mothers' educational level	
Elementary school	1 (0.3)
Intermediate school	9 (3.0)
High school	60 (19.8)
University degree	165 (54.5)
MSc/PhD	68 (22.4)
Fathers' educational level	
Elementary school	2 (0.6)
Intermediate school	12 (3.9)
High school	60 (19.7)
University degree	156 (51.3)
MSc/PhD	74 (24.3)
Mothers' occupation	
Employees with university degree	155 (52.0)
Retired	6 (2.0)
Unemployed	18 (6.0)
Employees without university degree	30 (10.1)
Blue collar employees	9 (3.0)
Free-lancers	44 (14.8)
Domestic	36 (12.1)
Fathers' occupation	
Employees with university degree	156 (52.0)
Retired	11 (3.7)
Unemployed	10 (3.3)
Employees without university degree	46 (15.3)
Blue collar employees	33 (11.0)
Free-lancers	44 (14.7)
Rent a house	
No	198 (64.7)
Yes	72 (23.5)
Don't know	36 (11.8)
Car	
No	6 (2.0)
Yes	300 (98.0)
Number of cars	1.7 (0.7)†

† mean (standard deviation)

Table 2. Dietary habits and attitudes of children and their families.

Characteristic	N (%)
Junk food consumption	
No	55 (19.4)
Yes	229 (80.6)
Number of junk food per week	1.4 (1.4)†
Days of breakfast with parents per week	
0 days	18 (5.9)
>1 days	286 (94.1)
Days of breakfast with parents per week	5.1 (2.5)†
Days of lunch with parents per week	
0 days	14 (4.6)
>1 days	290 (95.4)
Days of lunch with parents per week	5.2 (2.4)†
Days of consumption soft drinks per week	
0 days	118 (39.1)
>1 days	184 (60.9)
Days of consumption soft drinks per week	1.3 (1.6)†
Family member with an eating disorder (anorexia nervosa or bulimia nervosa)	
No	264 (86.8)
Yes	10 (3.3)
Don't know	30 (9.9)
Family member on a diet during the last year	
No	97 (31.7)
Yes	170 (55.6)
Don't know	39 (12.7)
Conversation with family about dietary issues	
Never	20 (6.5)
Rarely	74 (24.2)
Sometimes	87 (28.4)
Often	72 (23.5)
Very often	53 (17.3)
Conversation with friends about dietary issues	
Never	102 (33.3)
Rarely	110 (35.9)
Sometimes	56 (18.3)
Often	29 (9.5)
Very often	9 (2.9)

† mean (standard deviation)

Table 3. Bivariate analyses between determinants and overweight/obese children.

Characteristic	Children according to body mass index		P value
	Normal	**Overweight/obese**	
Sex			$<0.001^{\dagger}$
Girls	125 (94.0)	8 (6.0)	
Boys	112 (78.9)	30 (21.1)	
Children's age	$12.6 (1.7)^{\ddagger}$	$13.1 (1.6)^{\ddagger}$	$0.10^{\S}$
Mothers' age	$41.9 (4.7)^{\ddagger}$	$43.8 (4.3)^{\ddagger}$	$0.02^{\S}$
Television in children's room			$0.005^{\dagger}$
No	192 (89.3)	23 (10.7)	
Yes	45 (75.0)	15 (25.0)	
Hours of daily personal computer/video games machine/mobile/tablet	$1.3 (11)^{\P}$	$2 (11)^{\P}$	$0.09^{\dagger\dagger}$
Days of dog walking per week	$0 (21)^{\P}$	$0 (7)^{\P}$	$0.10^{\dagger\dagger}$
Days of consumption soft drinks per week			$0.05^{\dagger}$
0 days	94 (91.3)	9 (8.7)	
>1 days	139 (82.7)	29 (17.3)	
Family member on a diet during the last year			$0.08^{\dagger}$
No	73 (92.4)	6 (7.6)	
Yes	133 (84.2)	25 (15.8)	

Values are expressed as n (%) unless otherwise are indicated.

[†] x^2 test [‡] mean (standard deviation) [§] independent samples t-test [¶] median (range) [††] Mann-Whitney test

Results

Demographic characteristics of children are presented in Table 1. Fifty percent of children were girls, while their mean age was 12.7 years.

Mean BMI of children was 18.1kg/m^2. Seventy-seven point five percent of children had BMI within normal range, 10.1% were underweight, 12.1% were overweight and 0.3% were obese. In particular, 19.6% of boys and 4.6 of girls were overweight, while 0.6% of girls and 0% of boys were obese.

Seventy-eight point eight percent (n=241) of children did not have television in their room, while 21.2% (n=65) did have. Mean daily hours of watching television/DVDs was 1.77 (1.42), while mean daily hours of personal computer/video games machine/mobile/tablet use and hours of internet use were 2 (2) and 1.3 (1.6) respectively.

Eighty-seven point five percent (n=265) of children participated in activities outside school, 62.7% (n=188) did bicycling, 60.2% (n=183) moved to school on foot, 35.5% (n=108) moved by a car/bus and 4.3% (n=13) moved by a bicycle. Mean number of dog walking was 1.1 (2.5) per week. Mean duration of night sleep was 8.33 hours (1.09).

Dietary habits of children are presented in Table 2. Eighty point six percent of children ate junk food during a week, 60.9% drank soft drinks >1 times per week, 94.1% ate breakfast with their parents >1 times per week and 95.4% ate lunch with their parents >1 times per week.

Attitudes of children with regards to dietary issues are presented in Table 2. Eighty-six point eight percent of children did not have a family member with an eating disorder, 55.6% had a family member on a diet during the last year, 28.4% stated that discuss dietary issues sometimes with their family and 35.9% stated that discuss dietary issues a few times with their friends.

Bivariate analyses identified that children's BMI was associated with children's sex and age, mothers' age, television in children's room, hours of personal computer/video games machine/mobile/tablet use, days of dog walking per week, days of soft drinks consumption per week and existence of a family member on a diet during the last year (Table 3). Multivariate logistic regression analysis identified that boys (odds ratio [OR]=3.54, 95% confidence interval [CI]=1.51 to 8.31, p-value=0.004), children with television in their room (OR=2.73, 95% CI=1.26 to 5.92, p-value=0.011) and children who used personal computer/video games machines /mobile/tablet (OR=3.24, 95% CI=1.42 to 7.37, p-value=0.005) were more overweight/obese.

Discussion

In our study, the prevalence of overweight/obesity of 10 to 15 years-old children was 12.4%. The prevalence of overweight/obesity for boys and girls was 19.6% and 5.2% respectively. A study in Thessaloniki, Greece, found that the prevalence of overweight/obesity of 11 to 17 years-old children was 10.8% (Krassas et al, 2001).

In 2003, the Hellenic Medical Association for Obesity in a national study in Greece with 18,045 children found that the prevalence of overweight/obesity for children 2 to 19 years-old was 22.7% for boys and 18.3% for girls (Hellenic Medical Association for Obesity, 2003).

In a national study with 4.299 children 11 to 16 years-old the prevalence of overweight/obesity was 17.3% and in particular 24.2% and 10.3% for boys and girls respectively (Karayiannis et al, 2003).

Another national study found that the prevalence of overweight/obesity for children 6 to 17 years-old was 19.2% and in particular 16.4% for girls and 22% for boys (Georgiadis & Nassis, 2007). In the most recent national study in Greece with the participation of 4,786 children 10 to 12 years-old, the prevalence of overweight/obesity was 40.3% and in particular 42.6% and 38.5% for boys and girls respectively (Farajian et al, 2012).

Recent studies in Europe after 2000 found that the prevalence of overweight/obesity in children was 26.8% in Austria, 8.9% in Belgium, 18% in Bulgaria, 32.1% in Cyprus, 10% in Denmark, 15.7% in French, 26.6% in Germany, 21.3% in Hungary, 29.3% in Italy, 35% in Malta, 31.3% in Portugal, 31.3% in UK, 14.7% in Spain, 21.7% in Sweden and 18.5% in Turkey (Moreno et al, 2011).

In addition, in 2008 in Australia the prevalence of overweight/obesity in children was 27%, in 2007 in New Zealand was 30% and in 2012 in USA was 20.5% (Moreno et al, 2011; Ogden et al, 2014).

In our study we found that the prevalence of overweight/obesity of 10 to 15 years-old children was higher in boys than in girls. This finding is similar to previous data from studies in Greece (Hellenic Medical Association for Obesity, 2003; Karayiannis et al, 2003; Georgiadis & Nassis, 2007; Farajian et al, 2012; Birbilis et al, 2013) and worldwide (Kautiainen et al, 2005; Lazzeri et al, 2014).

This may be happens because family and especially mothers encourage more often daughters than sons to have a healthy diet in order to maintain a normal weight body (Schreiber et al, 2014; Rodgers et al, 2009). Also, media highlight the pattern of a thin body and this obsession affects girls more often than boys.

Moreover, the western lifestyle demands the woman to be beautiful and fit and diversions from this pattern affect women's psychology in a negative way (Gorgan, 2006). In addition, mothers are more often in diet than fathers and this affects emotionally in a greater way girls than boys to be in diet.

We found that children with television in their room were more often overweight/obese. Similar study found that children with television in their room were 1.32 times more often overweight/obese than children without television in their room (Adachi-Mejia et al, 2007).

A study found that television in children's room was associated with increasing time of watching television (Barr-Anderson et al, 2008) and other studies found that increasing time of watching television was associated with increased prevalence of overweight/obesity (Vicente-Rodríguez et al, 2008; Braithwaite et al, 2013).

Probably this happens because children consume foods rich in calories and low in nutritional value during the time that watch television.

According to studies children consume in a great way unhealthy foods such as soft drinks, sweets, chips, biscuits etc. during the time that watch television and do not consume healthy foods such as fruits and vegetables (Vereecken et al, 2005; Wiecha et al, 2006). Also, advertisements in television affect children in order to increase the consumption of unhealthy foods, rich in fat and calories.

In addition, watching television increases daily consumption of calories due to increased number of snacks that children eat and decreases the hours that children spend for their physical activity. This lifestyle increases sedentary life, decreases energy consumption and affects negatively the metabolism. Finally, television in children's room decreases duration of sleep leading to increased prevalence of childhood overweight/obesity (Seegers et al, 2011; Nielsen et al, 2011).

We found that increased hours of personal computer/video games machine/mobile/tablet use was associated with increased childhood overweight/obesity. This finding is confirmed by other studies (Epstein et al, 2008; Chaput et al, 2006; Stettler et al, 2004). A study found (O'Loughlin et al, 2000) that everyday playing of video games is associated with increased overweight/obesity of girls, while another study (Kautiainen et al, 2005) found that increased use of personal computer is associated with increased prevalence of obesity in girls. Also, increased use of video games machine during the weekend is associated with increased prevalence of childhood obesity.

Probably, the increased use of personal computer/video games machine/mobile/tablet is associated with increased children's sedentary life and decreased physical activities and duration of sleep, situations that lead to overweight/obesity.

Our study has several limitations. First of all, we conducted a cross-sectional study and this kind of study has an inherent bias since the chronological order between the determinants and the outcome is unknown and the inference of causal relationships is impossible.

For example, in our study unfortunately it is unknown whether the increased use of personal computer/video games machine/mobile/tablet preceded or not the occurrence of overweight/obesity.

The only way to tackle this bias is to conduct cohort studies with children with normal BMI at the start of the study, but cohort studies are more

expensive and difficult in design, demand greater number of participants and researchers have to wait for a long time for results.

We investigated a great number of determinants of childhood overweight/obesity but certainly there are more determinants to study such as psychological and genetic factors. We conducted our study in an urban city of Greece and generalization of results should be with great caution. Fortunately, we chose the participating schools in a random way and also the response rate was extremely high decreasing selection bias.

Also, our study population consisted of Greek children aged 10-15 years and one should be cautious with expanding the results of the study to other age groups.

In our study, children self-estimate their weight and height since in the pilot study a great number of children (28 out of 30) denied to measure their weight and height on a standardized equipment by the researchers (bathroom scale and aluminum anthropometer).

Obviously, children tent to overestimate their height and underestimate their weight leading to decreased BMI and the following prevalence of overweight/obesity.

Conclusion

The importance of this study is due to the fact that the knowledge of determinants of childhood overweight/obesity is necessary for the design and the implementation of the appropriate health politics.

In that case, children, family, teachers and others will have the chance to understand better the childhood overweight/obesity in order to make up the appropriate attitudes and to take measures for the treatment of one of the biggest public health problems.

Place in which the research carried out

The work was carried out at the University of Piraeus, Department of Economics, 80 M. Karaoli & A. Dimitriou street, GR-18534

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