ΓΕΩΠΟΝΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ
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Εκτίμηση επιπέδων της παιδικής και προεφηβικής παχυσαρκίας και της αιτιολογίας της σε επίπεδο περιβάλλοντος, διατροφικών συνηθειών και συνηθειών σωματικής δραστηριότητας, σε Πανελλαδικό αντιπροσωπευτικό δείγμα του πληθυσμού

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ΑΘΗΝΑ

ΦΕΒΡΟΥΑΡΙΟΣ 2014

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Σκοπός-Αντικείμενο: Ο σκοπός της συγκεκριμένης διδακτορικής διατριβής ήταν να εκτιμήσει τα επίπεδα υπέρβαρου και παιδικής παχυσαρκίας στην Ελλάδα σε αντιπροσωπευτικό πανελλαδικό δείγμα μαθητών δημοτικού, ηλικίας 10-12 ετών. Επιπρόσθετοι στόχοι ήταν η ταυτοποίηση των διατροφικών παραγόντων, των συνηθειών του τρόπου ζωής των παιδιών και σωματικής δραστηριότητας, αλλά και της οικογένειας που επηρεάζουν τον επιπολασμό της παιδικής παχυσαρκίας. Επίσης σκοπός ήταν να εκτιμηθεί η συνολική πρόσληψη νατρίου και να μελετηθούν οι επιδράσεις της στα επίπεδα αρτηριακής πίεσης (ΑΠ).

Μεθοδολογία: Η δειγματοληψία ήταν τυχαία και διαστρωματοποιημένη ανά γεωγραφική περιοχή (10 περιφέρειες) με σκοπό να μελετηθούν δεδομένα από 5000 παιδιά. Εκτός από τις ανθρωπομετρικές μετρήσεις και τις μετρήσεις ΑΠ που πραγματοποιήθηκαν στα σχολεία, τα παιδιά συμπλήρωσαν ένα ημι-ποσοτικοποιημένο ερωτηματολόγιο συχνότητας κατανάλωσης τροφίμων, αλλά και ειδικά σχεδιασμένα ερωτηματολόγια αξιολόγησης διατροφικών-γευματικών συνηθειών και εκτίμησης της σωματικής δραστηριότητας. Ο διεθνής δείκτης KIDMED χρησιμοποιήθηκε για την αξιολόγηση της εφαρμογής της Μεσογειακής Διατροφής (ΜΔ) από τα παιδιά. Οι γονείς/κηδεμόνες των παιδιών εκτός από τη συγκατάθεσή τους για την πραγματοποίηση μετρήσεων στα παιδιά τους κλήθηκαν να συμπληρώσουν ερωτηματολόγια συλλογής των παρακάτω πληροφοριών: δημογραφικά, ανθρωπομετρικά στοιχεία (αυτοδηλούμενα), κοινωνικο-οικονομικά στοιχεία, αντιλήψεις για τη διατροφή και το σωματικό βάρος του παιδιού, δεδομένα για την αξιολόγηση του βαθμού εφαρμογής της ΜΔ.

Αποτελέσματα: Σύμφωνα με τα κριτήρια του IOTF στο συνολικό Πανελλαδικό δείγμα παιδιών το ποσοστό υπέρβαρου και παχυσαρκίας ήταν 29,5% και 11,7%, αντίστοιχα. Το ποσοστό των παιδιών που είχαν καλή εφαρμογή της ΜΔ ήταν 4,3%. Οι παράγοντες που φάνηκαν να επηρεάζουν την πιθανότητα εμφάνισης υπέρβαρου/παχυσαρκίας ήταν η συχνότητα κατανάλωσης πρωινού γεύματος, ο συνολικός ημερήσιος αριθμός γευμάτων και μικρο-γευμάτων, η συχνότητα οικογενειακών γευμάτων, η ύπαρξη τηλεόρασης και ηλεκτρονικού υπολογιστή στο υπνοδωμάτιο των παιδιών και οι ώρες μελέτης των μαθημάτων τις καθημερινές. Από τα δεδομένα που συλλέχθηκαν από τους γονείς, οι παράγοντες που φάνηκαν να επηρεάζουν την πιθανότητα εμφάνισης υπέρβαρου/παχυσαρκίας ήταν η ηλικία της μητέρας, ο ΔΜΣ μητέρας και πατέρα και η λανθασμένη αντίληψη-αξιολόγηση για το σωματικού βάρος του παιδιού. Για το 23% του δείγματος η πρόσληψη διαιτητικού νατρίου ξεπερνούσε τα 2200 mg/ημέρα, ενώ το 34% της συνολικής πρόσληψης νατρίου προερχόταν από "κρυφές" διατροφικές πηγές, όπως το ψωμί, τα επεξεργασμένα δημητριακά, τα λευκά και κίτρινα τυριά. Οι παράγοντες που φάνηκε να συσχετίζονται με τα επίπεδα της ΑΠ των παιδιών ήταν το διατροφικό πρότυπο που χαρακτηριζόταν κυρίως από την υψηλή κατανάλωση τυριών και αλλαντικών κόκκινου κρέατος, η ύπαρξη υπέρβαρου και παχυσαρκίας και η κατανάλωση πρωινού.

Συμπεράσματα: Τα αποτελέσματα της Πανελλαδικής μελέτης δείχνουν ότι το πρόβλημα της παιδικής παχυσαρκίας είναι ιδιαίτερα έντονο και συνδυάζεται με χαμηλή εφαρμογή της ΜΔ. Επιπρόσθετα τα παιδιά είχαν υψηλή πρόσληψη διαιτητικού νατρίου από "κρυφές" διατροφικές πηγές. Τα αποτελέσματα της διατριβής μπορούν να χρησιμοποιηθούν για το σχεδιασμό μελλοντικών μελετών παρέμβασης ή για την εφαρμογή προγραμμάτων δημόσιας υγείας για την πρόληψη ή αντιμετώπιση της παιδικής παχυσαρκίας και του ζητήματος της αυξημένης ΑΠ στην παιδική ηλικία.

Επιστημονική Περιοχή: Επιδημιολογία της διατροφής

Λέξεις κλειδιά: Παιδιά, υπέρβαρο, παχυσαρκία, Μεσογειακή διατροφή, νάτριο, αρτηριακή πίεση

Abstract

Objective: In order to provide estimates of overweight (OW) and obesity (OB) among Greek schoolchildren, and the adherence rates to the Mediterranean diet (MD), a nationwide cross-sectional survey was performed among fifth and sixth grade students aged 10-12 years old. Another objective of the present PhD thesis was to recognize the most important dietary and physical activity habits plus parental influences that are associated with childhood OW and OB. Finally, the thesis also aimed to identify total sodium intake, and to investigate possible associations of dietary patterns with high blood pressure (BP).

Methods: A stratified sampling in 10 regions of the country was applied to voluntarily enroll a representative sample of 5000 children. Children's anthropometric and BP measurements were performed in their school-setting, and children completed specially designed questionnaires allowing us to assess dietary information and physical activity levels. Parental self-reported anthropometric values, perceptions, and family environment information were also obtained. The KIDMED index was used to evaluate the degree of adherence to the MD.

Results: OW and OB prevalence was 29.5% and 11.7%, respectively. Only 4.3% of the children had an optimal KIDMED score. The most important predictors of childhood OW/OB were breakfast frequency, daily number of meals and snacks, the frequency of family meals, having both TV and PC/Videogame player in the bedroom, and studying hours in weekdays. In the case of parents, mothers' age, maternal and paternal BMI, and children's BMI misclassification were significant predictors of children’s OW/OB. Twenty-three percent of Greek children had sodium intake which exceeded the 2200 mg per day recommendation. Thirty-four percent of sodium intake from “hidden” sources came from bread, processed cereals and white cheese. Predictors of high blood pressure were a pattern mainly characterized by the high consumption of cheese and red processed meat, being overweight or obese, and breakfast frequency.

Conclusions: The prevalence of childhood OW and OB in Greece was very high, exceeding 40%, in conjunction with low adherence rates to the MD. In addition, Greek children had an elevated sodium intake from “hidden” sources. These findings could guide future interventions or public

health initiatives to prevent and confront the childhood obesity epidemic and the problem of elevated BP levels more efficiently.

Scientific area: Nutritional Epidemiology

Keywords: Children,overweight, obesity, Mediterranean diet, sodium, blood pressure

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List of Papers

I. **Farajian P**, Risvas G, Karasouli K, Pounis GD, Kastorini CM, Panagiotakos DB, Zampelas A. Very high childhood obesity prevalence and low adherence rates to the Mediterranean diet in Greek children: The GRECO study. *Atherosclerosis* 2011; 217:525-30.

II. **Farajian P**, Panagiotakos DB, Risvas G, Karasouli K, Bountziouka V, Voutzourakis N, Zampelas A. Socio-economic and demographic determinants of childhood obesity prevalence in Greece: the GRECO (Greek Childhood Obesity) study. *Public Health Nutr* 2013; 16:240-7.

III. Risvas G, Papaioannou I, Panagiotakos DB, **Farajian P**, Bountziouka V, Zampelas A. Perinatal and family factors associated with preadolescence overweight/obesity in Greece: the GRECO study. *J Epidemiol Glob Health* 2012; 2:145-53.

IV. **Farajian P**, Panagiotakos DB, Risvas G, Malisova O, Zampelas A. Hierarchical analysis of dietary, lifestyle and family environment risk factors for childhood obesity: the GRECO study. 2014 (Submitted manuscript in the *Eur J Clin Nutr*)

V. **Farajian P**, Bountziouka V, Risvas G, Panagiotakos DB, Zampelas A. Anthropometric, lifestyle and parental characteristics associated with the prevalence of energy intake misreporting in children: the GRECO study. 2014 (Submitted manuscript in the *Br J Nutr*)

VI. Magriplis E, **Farajian P**, Pounis GD, Risvas G, Panagiotakos DB, Zampelas A. High sodium intake of children through 'hidden' food sources and its association with the Mediterranean diet: the GRECO study. *J Hypertens* 2011; 29:1069-76.

VII. **Farajian P**, Panagiotakos DB, Risvas G, Micha R, Zampelas A. A dietary pattern characterized by high cheese and red processed meat consumption is associated with higher blood pressure in children. 2014 (Submitted manuscript in the *Am J Clin Nutr*)

Abstracts published in conference proceedings (Presented in Appendix 1)

I. **Farajian P**, Karasouli K, Risvas G, Panagiotakos DB, Zampelas A. Repeatability and validity of a food frequency and dietary habits questionnaire in children. *Circulation* 2009;119:e288 (abstr).

II. Bountziouka V, **Farajian P**, Risvas G, Malisova O, Panagiotakos DB, Zampelas A. Development and validation of a semi-quantitative food frequency questionnaire for young school-aged children. *Annals of Nutrition & Metabolism* 63 (Suppl 1):1-1960, 2013 (abstr).

III. **Π. Φαρατζιάν**, Δ. Παναγιωτάκος, Γ. Ρίσβας, Ρ. Μίχα, Α. Ζαμπέλας. Διατροφικοί παράγοντες και οικογενειακές συνήθειες που επηρεάζουν τα επίπεδα υπέρβαρου/παχυσαρκίας στα παιδιά: Η μελέτη GRECO**.** 6ο Εντατικό Σεμινάριο στην Εφηβική Ιατρική, 2013. (*Η εργασία τιμήθηκε με το 1ο βραβείο της Ελληνικής Εταιρίας Εφηβικής Ιατρικής "Γεώργιος Μαραγκός")*

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Abbreviations

ANOVA	Analysis Of Variance
AO	Abdominal Obesity
BF	Body Fat
BMI	Body Mass Index
BMR	Basal Metabolic Rate
BP	Blood Pressure
CI	Confidence Intervals
CRP	C-Reactive Protein
CVD	Cardiovascular Disease
DASH	Dietary Approaches to Stop Hypertension
DBP	Diastolic Blood Pressure
EI	Energy Intake
EU	European Union
FFQ	Food Frequency Questionnaire
GRECO study	GREek Childhood Obesity study
HDL	High Density Lipoprotein cholesterol
IGF-1	Insulin-like Growth Factor-1
IOTF	International Obesity Task Force
KIDMED score	Mediterranean diet quality index for children and adolescent score
KMO	Kaiser–Meyer–Olkin
LDL	Low Density Lipoprotein cholesterol
MAI	Mediterranean Adequacy Index
MD	Mediterranean diet
MVPA	Moderate to Vigorous Physical Activity
NHANES	National Health and Examination Surveys
NW	Normal Weight
OB	Obesity
OR	Odds Ratio
ORP	Over-Reporting

OW	Overweight
PAL	Physical Activity Level
PAQ-C	Physical Activity Questionnaire for older Children
PC	Personal computer (computer)
PCA	Principal Components Analysis
SBP	Systolic Blood Pressure
SD	Standard Deviation
SES	Socio-Economic status
SPSS	Statistical Package for Social Sciences
SSBs	Sugar Sweetened Beverages
TV	Television
UK	United Kingdom
URP	Under-Reporting
US	United States
WC	Waist Circumference
WHO	World Health Organization

1. Introduction - Literature Review

1.1 Prevalence of obesity in the United States and Europe

Paediatric obesity (OB) has been described as the primary childhood health problem in developed nations, having been linked to many serious physical, social and psychological consequences (Ebbeling et al, 2002). These include increased risk of cardiovascular dysfunction, type 2 diabetes, and pulmonary, hepatic, renal and musculoskeletal complications; lower health-related quality of life; negative emotional states such as depression, low self-esteem, and nervousness, and even increased likelihood of engagement in high-risk behaviors or poor academic performance (Ebbeling et al, 2002; Freedman et al, 1999; Freedman et al, 2007; Han et al, 2010; Reilly et al, 2003). The prevalence of overweight is significantly higher in economically developed regions, but is rising significantly in most parts of the world. In many countries the problem of childhood obesity is worsening at a dramatic rate (Lobstein et al, 2004b), although there are recent reports highlighting that the rise in the prevalence of childhood and adolescent overweight and obesity in some developed countries is slowing or even plateauing (Olds et al, 2011). Nevertheless, there are still many to debate this observation. According to Reilly (2012) this observed leveling-off may represent a temporary pause in the epidemic rather than any long-term change, and there may be a degree of bias in published studies [increasing underrepresentation of the overweight and obese]. It is also likely that simple indices for excess adiposity, such as the BMI, are too crude to detect subtle population changes in body fatness or changes in body fat distribution, which is considered to be the main characteristic in overweight (OW) and obese subjects causing most of the adverse health effects.

In the United States, where the scientific and public interest in childhood obesity has been intense over the last decades, the National Health and Examination Surveys (NHANES) document steady increases from the late 1970s to 2004 in the prevalence of overweight (having a body mass index – BMI – above the age and sex-specific 95th percentile of the US growth reference) and at risk of overweight (BMI between the 85th and 95th percentile) among children and adolescents, ages 2 to 18 years. The percentage of overweight youth increased sharply from 1999 to 2004, so that by 2004, 17.1% of American children and adolescents were overweight, and an additional 16.5% were at risk of overweight. In addition, nearly 14% of 2–5-year old children and 19%of 6–11-year old children were overweight (Ogden et al, 2006). According to Ogden et al (2012), presenting the overweight and obesity prevalence with measured weights and heights from the NHANES surveys, although significant increases in obesity prevalence were seen in both sexes of children and adolescents during the 1980s and 1990s, between 1999-2000 and 2007-2008, significant increases were seen only at the highest cut point of BMI, corresponding to the 97th percentile, in 6- through 19-year-old males. No change at any cut point was seen in females. Furthermore, when comparing 2009-2010 obesity prevalence with 2007-2008, no difference were observed for children and adolescents. However, overall trend analysis in obesity prevalence between 1999-2000 and 2009-2010 among children and adolescents aged 2 through 19 years indicated a significant increase for males but not for females.

Following the worldwide trend, studies performed during the last decades in European childhood and adolescent populations show a considerable increase in OW and OB prevalence, although there are significant geographical disparities. According the review of Lobstein & Frelut (2004a) using data from 21 studies in European countries using the International Obesity Task Force (IOTF) internationally accepted definition of childhood and adolescent OW and OB (Cole et al, 2000), two trends were evident. First was the generally lower levels of OW found among children in the countries of central and eastern Europe whose economies suffered varying degrees of recession during the period of economic and political transition in the 1990s. The second trend apparent for the prevalence of overweight were the higher rates among the southern countries of Europe, especially countries surrounding the Mediterranean. Specifically, the prevalence rates for overweight children in Mediterranean countries were 20–35%, while those in northern areas were considerably lower and reached 10–20%. This particular review was the first to emphasize to the severity of the problem in Europe, and to make clear that OW and OB is not a public health issue only detected in the US.

Since then, many nationally representative studies were published demonstrating the severity of the problem in European countries. In the study published by Lissau et al (2004), concerning cross-sectional representative self-reported data during 1997-1998, from 13 countries (including the US), the highest prevalence of overweight in adolescents was found in the US, Greece, Ireland and Portugal, without showing, though, so significant geographical disparities. Under the context of the IDEFICS project, where databases analysis of surveys on childhood overweight and obesity carried out from 1995 to 2005 in five European countries was performed, and by defining OW and OB according to the IOTF definition (Cole et al, 2000), the highest prevalence of overweight and obesity was observed in Italian children in both age groups (4-5 and 9-11) investigated. Importantly, this study besides providing useful data, highlighted that the validity of comparisons between different countries depends on the comparability of the survey methods and the availability of nationally representative data and not regional or local surveys. In another more recent study, analyzing six datasets of European preschoolers (4-7 years old), and based on objectively measured weight and height, prevalence of OW and OB across the countries ranged from 8% to 30% and 1% to 13%, respectively, with highest rates in Southern European countries (i.e. Spain and Greece) (van Stralen et al, 2012).

Despite the very high prevalence of OW and OB in European countries there are recent studies showing that rates of OW and OB are undergoing stabilization (Aeberli et al, 2008; Lioret et al, 2007; Stamatakis et al, 2010). In the United Kingdom for instance, approximately 10% of children are obese (defined as BMI in the 95th percentile relative to UK reference data from 1990) at the end of primary school (elementary school), and 25% of adolescents are obese at the end of high school (Reilly JJ, 2006). However, despite evidence of the leveling off (Stamatakis et al, 2010), there appears to have been continuing increases in prevalence among children and adolescents of low socioeconomic status. Therefore, one has to be cautious before creating complacency that the problem has been moderated. On the other hand, studies from South European countries demonstrate that the problem is escalating with subsequent adverse health consequences. In Portugal, Padez et al (2004) conducted a nationwide representative survey using objective anthropometric measurements. They assessed the prevalence of overweight and obesity in Portuguese children between the ages of 7 and 9 years, following the IOTF cutoffs. The study revealed a prevalence of overweight/obesity of 31.5% (of these, 11.3% were classified as obese). This study showed that the prevalence of overweight/obesity in Portuguese children is high when compared to other European countries, following the trend of other socio-cultural similar countries such as Spain, Italy and Greece. The authors also highlighted the strong increase in BMI among children between 1970 and 2002. In a recent national study in Italy aiming to estimate the prevalence of OW and OB in children 8-9 years old, and present geographical differences in the prevalence, at national level, 24% of children were overweight and 12% were obese according to IOTF criteria. The prevalence of overweight was similar for the three geographic areas, but obesity was 1.4 times higher in central than in northern Italy and 2.2 times higher in southern Italy, obviously related with differences in socio-economic status of the participants (Binkin et al, 2010). In Spain the study of Cuenca in the period 2004- 2010 reported that the prevalence of overweight and adiposity has continued to increase among boys but no changes in overweight and percentage body fat were shown for girls, while data from the same study regarding the period 1992-2004 had shown that the overall prevalence of overweight had increased from 24.4% in 1992 to 30.9% in 2004 (Martínez-Vizcaíno et al, 2012; Martínez-Vizcaíno et al, 2009). In the Spanish National Health Survey 2011- 2012, based on self parent-reported body weight and height, the estimated prevalence of overweight plus obesity was 29% in boys and 26.5% in girls aged 2-17 years, with higher rates in the 5-9 years old subgroup (Rodrigo CP, 2013). Finally, in a study aiming to report data on OB prevalence in Cypriot children aged 9-13 years old, children's height and weight were reported by parents via a questionnaire sent out from the schools. Obesity and overweight among children were calculated using the IOTF age- and gender-specific BMI cut-off criteria. Overall prevalence rates were 18.6% for overweight and 4.3% for obesity [Lazarou et al, 2008b].

1.2 Prevalence of childhood and adolescent obesity in Greece

Besides the studies previously mentioned describing the obesity prevalence in Greece and comparing it with other countries, in which data from surveys conducted in Greek children and adolescent populations were used and combined with other datasets from other European populations, during the last decade there has been a remarkable increase in the publication of studies providing data about the OW and OB health issue in Greece. Additionally, there are available nationwide data concerning the epidemiology of excess weight in these age groups, showing the magnitude of the problem (***Table 1***).

Studies reporting regional prevalence

Prevalence rates in OW and OB among children and adolescents in Thessaloniki were assessed by Krassas et al (2001) in a 2000-2001 survey of 2,458 children and adolescents aged 6-17 years. Among children aged 6-10 years, the percentages of OW and OB for boys were 26.6% and 6.5%, and 25% and 5% for girls, respectively. For adolescents aged 11-17 years, OW and OB rates for boys were 25.3% and 3.7%, respectively, whereas for girls they were 13% and 1.5%, respectively. Another study of 524 children from Thessaloniki aged 6-15 years old reported OW and OB rates of 21.1% and 8.4% in boys and 17.6% and 8.4% in girls, respectively (Papandreou et al, 2008). In the region of Attica in the period 2003 and 2004 (2,054 boys and 2,077 girls), Papadimitriou et al (2006) estimated that 27.8% of the boys were OW and 12.3% were OB, while in girls, the respective rates were 26.5% and 9.9%. During the same time period, a research in the Vyronas region of Athens showed OW and OB rates for boys aged 12-17 years of 19.2% and 4.4%, and for girls 13.2% and 1.7%, respectively (Kosti et al, 2007). Another study, of schoolchildren aged 10-12 from the Athens area which indicated an association between increased body weight and asthma symptoms, also confirmed the increased rates of overweight (34% and 22% for boys and girls, respectively) and obesity (9.4% and 8.6% for boys and girls, respectively) (Priftis et al, 2007). In the region of Crete a series of important studies further confirmed the high prevalence of OW and OB. Specifically, in a six-year longitudinal study children were measured prospectively at ages 6, 9, and 12 and it was demonstrated that Cretan children had higher mean BMI than similar American cohort and that there was an age-dependent increase in OB indices, regardless of gender (Mamalakis et al, 2000). Additionally, a comparison of 9 and 12 year-old boys from Crete during 1982 to 2002, found that the prevalence of combined OW and OB increased significantly, reflecting a 2.3-fold higher prevalence (Magkos et al, 2006).

Studies reporting national prevalence

The chronologically (years of data collection) first study presenting national data collected in 1990-1991 from students 6-17 years old reported that the overall prevalence of OW and OB was 17.3% and 3.6%, respectively (Georgiadis & Nassis, 2007). These data demonstrated a difference in the prevalence of OW and OB by age group, and highlighted that for girls, the most crucial period for OW development appears to be the ages from 6-9 years, while in boys the crucial period seems to be the ages from 10-17 years. In this study it was also shown that the prevalence of combined OW and OB did not differ between urban and semi-urban/rural areas. Thereafter, in the study of Karayiannis et al (2003), using self-reported anthropometric indices to assess obesity in children and adolescents, the overall prevalence of OW and OB in 11-16 years old children and adolescents was 15.3% and 1.8% respectively.

The Hellenic Medical Association for Obesity conducted a cross-sectional, nationwide epidemiological survey in 2003 to provide estimates of the prevalence of OW, OB, and abdominal obesity (AO) in 3,140 children aged 6-12 years and a total of 14,456 Greek adolescents aged 13-19 years (Tzotzas et al, 2008; Tzotzas et al, 2011). In the case of children 6-12 years old, OW including OB was 31% in boys and 26% in girls, while in adolescents it reached 29.4% in boys and 16.7% in girls. Concerning the prevalence of AO, based on the measurements of waist circumference, approximately 14% and 12% of girls and boys were categorized as obese. In adolescents, AO was significantly higher in girls than in boys (21.7% vs. 13.5%, respectively). Interesting findings of this study were that no differences were observed in the prevalence of OB, OW, or AO in both genders according to residence in urban, semiurban, or rural areas, and that OW, OB and AO were significantly more prevalent in Greek participants than in immigrants. In addition, under the context of the Healthy Growth study the total prevalence of overweight and obesity was 29.9% and 11.2%, respectively, with a significantly higher prevalence of obesity in boys than in girls (Moschonis et al, 2013). The study of Manios et al (2007) was the only one assessing OW and OB prevalence in preschoolers (aged 1-5 years). According to the results of the study and using the IOTF criteria the overall estimate of "at risk of overweight" and overweight was 21.3%. Furthermore, in a recently published paper examining 11-year trends (1997-2007) in overweight and obesity of 8-9 years old children, it was shown that the prevalence of overweight rose between 1997 and 2007 from 20.2 % to 26.7% for girls, and from 19.6% to 26.5% for boys (Tambalis et al, 2009). In addition, in the same study trend analysis showed an increase in the prevalence of obesity from 7.2% in 1997 to 11.3% in 2004 for girls and from 8.1% in 1997 to 12.3% in 2004 for boys. However, as it was highlighted by the authors, an apparent leveling off in obesity rates was observed during 2004-2007 for both boys and girls.

According to the study of Tambalis et al (2009), rates of OW in boys increased with a trend of 0.71 ± 0.1% per year, between 1997 and 2007. For girls, an increase in overweight rates was also evident with an annual increasing trend equal to 0.41 ± 0.05%. Similarly, in both boys and girls OB rates increased between 1997 and 2004, with an apparent leveling-off in the years after 2004, which according to the authors could mean that OB rates have reached a country specific ceiling, or that the cutoffs used for defining BMI categories need re-evaluation under the light of current metabolic and anthropometric data. Irrespectively of the reason, these encouraging results have to be verified in more long-term data in Greece, were according to the published data at present 40% of children and adolescents are OW and OB.

Table 1. Prevalence rates of overweight and obesity in Greek children and adolescents from nationwide studies [#]

Publication	Survey years	Sample size and age groups (yr)	Prevalence of OW/OB
Georgiadis & Nassis, (2007)	1991-1992	6448 children & adolescents, 6-17 yr	Total sample: 17.3% OW, 3.6% OB
Karayιannis et al, (2003) *	1997-1998	4299 children & adolescents, 11.5-15.5 yr	Boys: 21.7% OW & 2.5% OB Girls: 9.1% OW & 1.2% OB
Tzotzas et al, (2008)	2003	14456 adolescents, 13-19 yr	Boys: 23.3% OW & 6.1% OB Girls: 14.0% OW & 2.7% OB
Manios et al, (2007)	2003	2374 preschoolers, 1-5 yr	Boys: 12.9% OW & 6.2% OB Girls: 15.5% OW & 8.1% OB
Tzotzas et al, (2011)	2003	3140 children and preadolescents, 6-12 yr	Boys: 21.8% OW & 9.4% OB Girls: 20.1% OW & 6.4% OB
Moschonis et al, (2013)	2007	2073 children and preadolescents, 9-13 yr	Total sample:: 29.9% OW, 11.2% OB
Tambalis et al, 2009	1997-2007 11 year trend in OW and OB	651582 children, 8-9 yr	Boys: From 19.6 ± 0.2% in 1997 to 26.5 ± 0.2% in 2007 (OW) Girls: from 20.2 ± 0.2% in 1997 to 26.7 ± 0.2% in 2007 (OW) Boys: From 8.1 ± 0.2% in 1997 to 12.2± 0.2% in 2007 (OB) Girls: From 7.2± 0.2% in 1997 to 11.2± 0.2% in 2007 (OB)

OW: Overweight; OB: Obesity; Yr: Years

Obesity and overweight in all studies were calculated using the IOTF age- and gender-specific BMI cut-off criteria.

* Participants' weight and height were self reported.

1.3 The Mediterranean countries childhood obesity paradox

Recent findings from epidemiological studies in Europe support the suggested by Lobsten and Frelut (2004) tendency, showing that south European countries such as Spain, Italy, Portugal and Greece report higher prevalence of childhood and adolescent obesity when compared to north European countries. In addition, in a recent review article of Cattaneo et al (2010) aiming to synthesize all available information on prevalence and time trends of overweight and obesity in infants and pre-school children in the 27 countries of the European Union (EU), it was obvious that countries in the Mediterranean region and the British islands report higher rates than those in middle, northern and eastern Europe. The rapid increase in the prevalence of obesity in Mediterranean countries during the last decades, primarily suggests that behavioural factors play a role, these being influenced by genetic, social, and economic environments. Since adherence to the Mediterranean diet (MD) has been associated with lower BMI and obesity risk in adults (Buckland et al, 2008), it would be logical to believe that if it was adequately followed by children and adolescents, it could also be associated with lower OW and OB prevalence. However, before jumping into conclusions it would be useful to review the adherence rates of childhood Mediterranean populations in the MD scheme.

Children's adherence to the Mediterranean dietary pattern, has mainly been evaluated using a recently developed tool, the Mediterranean Diet Quality Index for children and adolescent score (KIDMED score) (Serra-Majem et al, 2004). The KIDMED index is based on the principles sustaining the Mediterranean dietary pattern as well as on those that undermine it (such as frequent consumption of fast-food and increased intake of sweets). The index includes 16 yes or no questions (***Table 2***). Questions denoting a negative connotation with respect to the MD are assigned a value of -1 and those with a positive aspect +1. The total score ranges from -4 to 12 and is classified into three levels: ≥8, optimal Mediterranean diet; 4–7, improvement needed to adjust intake to the Mediterranean diet pattern; and <3, very low diet quality.

Table 2. KIDMED test to assess the Mediterranean diet quality*

+1	Takes a fruit or fruit juice every day
+1	Has a second fruit every day
+1	Has fresh or cooked vegetables regularly once a day
+1	Has fresh or cooked vegetables more than once a day
+1	Consumes fish regularly (at least 2–3 times per week)
-1	Goes more than once a week to a fast-food (hamburger) restaurant
+1	Likes pulses and eats them more than once a week
+1	Consumes pasta or rice almost every day (5 or more times per week)
+1	Has cereals or grains (bread, etc.) for breakfast
+1	Consumes nuts regularly (at least 2–3 times per week)
+1	Uses olive oil at home
-1	Skips breakfast
+1	Has a dairy product for breakfast (yoghurt, milk, etc.)
-1	Has commercially baked goods or pastries for breakfast
+1	Takes two yoghurts and/or some cheese (40 g) daily
-1	Takes sweets and candy several times every day

KIDMED – Mediterranean Diet Quality Index in children and adolescents

* Adapted from: Serra-Majem et al (2004)

Regarding the adherence rates of children and adolescents to the MD, relatively recent studies have shown low to average compliance. In a study with a large sample of Spanish school-children aged 8-16 years, the KIDMED index classification among 8-10 year-olds was 'good' in 48.6% of the population, 'average' in 49.5% and 'poor' in 1.6%. Among the 10–16 year-olds, the KIDMED index classification was good in 46.9% of the population, average in 51.1% and poor in 2.0% (Mariscal-Arcas et al, 2008). Similarly, another study performed in Greek children and adolescents, demonstrated low adherence to the dietary patterns of the MD, since only 11.3% of children and 8.3% of adolescents had an optimal KIDMED score (Kontogianni et al, 2008). Data from one more Mediterranean country further support these alarming findings. In the national study of Lazarou et al (2008a) in Cypriot children, only 6.7% of the sample was classified as high adherers of MD, whereas 37% had a poor KIDMED score, while no differences were observed between boys and girls.

Concerning the relationship of the Mediterranean diet with childhood OW and OB, there are studies showing that KIDMED score is negatively associated with BMI (Kontogianni et al, 2008; Lazarou et al, 2008a), revealing a promising protective effect of the MD against the development of OW and OB. In a representative sample of young Spaniards, in which the association between waist circumference (WC) and adherence to the MD was examined, age-adjusted linear regression revealed an inverse association between KIDMED category and both WC and waist-to-height ratio (Schröder et al, 2010). Furthermore, after multivariate adjustment a 5-point increase in KIDMED score was associated with a mean decline of 1.54 cm in sex-, age- and height-adjusted WC. In another report under the context of the IDEFICS study, adherence to a Mediterranean-like dietary pattern was assessed through a modified version of the Mediterranean diet score based on the dietary data collected by a non-quantitative FFQ (Tognon et al, 2013). A large number of European children were measured at baseline and after two years. At baseline, high adherence to the MD was inversely associated with BMI as well as percentage of body fat even after adjusting for several potential confounders. Longitudinally, a Mediterranean-like dietary pattern was also inversely associated with the highest change in BMI and central obesity markers (waist circumference and waist-to-height ratio).

Regardless of the previously mentioned studies that show a potential protective effect of the MD scheme in children's OW and OB risk, the alarmingly low adherence rates of the Mediterranean childhood population to the MD and the phenomenon of the nutrition transition has been a topic for discussion for many researchers and could be related to the enhanced commercial availability of food, the overall improvement in socioeconomic conditions, and the high urbanization which has taken place in many Mediterranean countries (among which Greece as well) over the last decades. The increasing westernization and mechanization occurring in most countries around the world is associated with changes in the diet and lifestyle towards high fat and energy-dense foods, and a sedentary lifestyle (Roditis et al, 2009; WHO, 2003). According to the review of Swinburn et al (2004), a sharp decline in the cost of vegetable oils and sugar means that they are now in direct competition with cereals as cheap food ingredients. This has caused a reduction in the proportion of the diet that is derived from grain and grain products and has greatly increased world average energy consumption. In addition, the increasing prices of some of the major food items of MD pyramid seem to have led people to give up this eating pattern in favor of less expensive products which allow to save money but have been proven to be unhealthy (Bonaccio et al, 2012).

As populations become more urban and incomes rise, diets high in sugar, fat and animal products replace more traditional diets that were high in complex carbohydrates and fiber. Ethnic cuisine and unique traditional foods and eating habits are being replaced by westernized energy dense foods and increased meat consumption. In a very interesting study aiming to analyse the worldwide trends of the adherence to the MD, in 1961-1965 and 2000-2003, the Mediterranean Adequacy Index (MAI) was used (da Silva et al, 2009). This index is calculated by dividing the energy provided by the total sum of Mediterranean food groups by the energy from the non-Mediterranean food groups. According to this study, although Mediterranean countries showed the highest MAI values in both periods compared to the rest of the countries, also experienced a significant decrease in their MAI values. Especially Greece which had the greatest adherence in the 60s, experienced the greatest decrease in MAI value.

Moreover, Lobstein et al (2004a) suggested as a potential explanation the genetic predisposition towards weight gain among children in southern Europe, although this has not been verified in genetic studies. Additionally, the north–south variation in Europe could be explained by the warmer climates experienced in southern latitudes leading to reduced thermogenesis (i.e. reducing a child's need to expend energy to keep warm) or to increased sedentary behavior (perhaps owing to discomfort experienced when undertaking physical activity in hot climates). Further explanation for the very high OW and OB rates in Greece is given in the chapters below examining the prevalence of risk factors associated with the problem.

1.4 Health consequences of childhood obesity

It has been suggested that childhood obesity usually tracks into adult life, accompanied by an increased risk for several metabolic complications and chronic disease later in life (Freedman et al, 2004; Wright et al, 2001; Whitaker et al, 1997). In the study of Whitaker et al (1997) in the US it was shown that 69% of obese (defined as BMI >95th centile) 6–9 year olds were obese as adults. In the same cohort, 83% of obese (BMI >95th centile) 10–14 year olds became obese adults. In a systematic review published by Reilly et al (2013), the persistence of childhood obesity into adulthood was substantially more likely where children had at least one obese parent, when obesity was more severe (defined as BMI >95th centile compared to BMI >85th centile), and present at older ages. Adolescent obesity is probably even more likely to persist into adulthood than childhood obesity. According to the authors the persistence of childhood obesity into adulthood should now be more likely than in the past, given the much higher prevalence of adult obesity in contemporary populations and the known increasing risk for childhood and adolescent OW and OB, when having OW or OB parents.

1.4.1 Short-term consequences of childhood obesity

Perhaps the most significant short-term morbidities for OW/OB children are psychosocial and include social marginalization, decreased self-esteem, and decreased quality of life (French et al, 1995; Strauss et al, 2003; Whitlock et al, 2005). Girls are at greater risk than boys, and the risk of psychological morbidity increases with age. Low self esteem and behavioral problems have been shown to be commonly associated with OB (Reilly et al, 2013).

Besides the psychological burden of OW/OB in children and adolescents, childhood OW/OB can adversely affect almost every organ system and often has serious consequences, including hypertension, dyslipidaemia, insulin resistance or diabetes, and fatty liver disease (Daniels SR, 2009). The atherosclerotic process seems to be accelerated in obese children and almost half of children with BMI higher than the 97th percentile have one or more of the disorders that make up the metabolic syndrome (Freedman et al, 2008; Calcaterra et al, 2008), which are associated with more extensive fatty streaks and fibrous plaques in later life (Berenson et al, 1998). In the systematic review of Reilly et al (2013) a consistent association was demonstrated between OB and most of the major cardiovascular risk factors (i.e. high blood pressure; dyslipidaemia; abnormalities in endothelial function; and hyperinsulinaemia and/or insulin resistance). For example, Freedman and colleagues (1999), using an obesity definition of BMI >95th centile in a sample of 5–10 year olds from the USA, reported significant odds ratios for raised diastolic blood pressure and systolic blood pressure, raised LDL cholesterol (defined as >130 mg/dl), low HDL cholesterol (defined as <35 mg/dl), raised triglycerides (defined as >130 mg/dl), and high fasting insulin concentration (defined as >95th centile). In another more recent report from the Bogalusa Heart study (Freedman et al, 2007) it was found that waist-to-height ratio and BMI-for age showed similar associations with CVD risk factors, thus highlighting the usefullnes and significance to assess central obesity indices.

Concerning hypertension in children and adolescents, while few would dispute the importance of taking effective steps to assess and manage this condition in adults, relatively little attention was paid to the problem of high blood pressure (BP) in children until recently. It is now established, that high BP is detectable in children and adolescents, it is relatively common, and is increasing in prevalence (Falkner et al, 2010; Feber & Ahmed, 2010). The negative and potentially severe consequences of high BP are not only limited to adulthood, but also during the early ages. Evidence of end organ damage, such as left ventricular hypertrophy, pathological vascular changes, and possible renal dysfunctions have been found even in young children with high BP (Feber & Ahmed, 2010). Even central nervous system end-organ damage, which manifest as reduced cognitive function and poorer performance on selected tests of cognition, have also been detected among children with high BP, compared with normotensive children (Drukteinis et al, 2007). In addition, it has been shown that elevated BP in children continues into adulthood and that systolic BP (SBP) that meets the definition of high BP at any age increases the odds of developing high BP in adulthood (≥30 years) by 3- to 4-fold compared with children whose SBP is normal (National High Blood Pressure Education Program Working Group, 2004).

Recent studies reveal increasing trends of average BP in children and adolescents. In particular, data from the US National Health and Nutrition Examination Surveys showed that after age, race/ethnicity and sex standardization, systolic and diastolic BPs were respectively 1.4 and 3.3 mmHg higher in 1999-2000 compared with 1988-1994 (Muntner et al, 2004). A more recent paper from the NHANES concerning data from 2003-2006 measurements of children and adolescents 8-17 years old reported that 13.6% of the boys and 5.7% of the girls were classified as having pre-elevated BP and 2.6% of the boys aged 8–17 and 3.4% of the girls aged 8–17 were classified as having elevated BP. The same study showed that OW and obese boys and girls were significantly more likely to be classified as having pre-EBP and having EBP after controlling for all other covariates, an association also verified in many previous studies worldwide (Ostchega et al, 2009). This association and the parallel increase of the worldwide prevalence of OW/OB is according to many experts the main reason for the increase of primary hypertension in children. The exact prevalence of childhood hypertension is difficult to assess, as the results vary significantly depending on selection of children for the surveys (i.e. population compared with school-based survey), BP measurement methods, number of BP readings, and ethnic differences around the world. It is therefore difficult to compare the data from different studies from around the world.

In Greece during the last decade there is a number of studies confirming the global trend of elevating BP levels (***Table 3***), while it is noteworthy that some of the studies report extremely high prevalence of hypertension. It should be mentioned, however, that when BP is assessed in a single visit, there is a significant risk of overestimating the level of BP and thereby the prevalence of high BP. Measurements of BP in at least three office visits are needed for a reliable diagnosis of hypertension to be made (National High Blood Pressure Education Program Working Group, 2004). Furthermore, a significant proportion of participants with elevated BP in repeated office visits have normal BP out of the office (with ambulatory or home BP monitoring) and are classified as white coat hypertensives. A recent school-based study conducted during 2004 and 2005 in 765 participants aged 6–18 years in Athens, reported that 8.6% of the participants were classified as hypertensive on the basis of BP measurements of a single office visit, yet 70% of them had normal home BP and were classified as white coat hypertensives (Stergiou et al, 2008). Hence, recently Stergiou et al (2007) in order to avoid the white-coat and the masked hypertension phenomenon (normal office but elevated out-of-office BP) which appear to be common in children and adolescents, have provided us with reference values for home BP monitoring in children.

Besides the association of elevated blood pressure levels with a sedentary lifestyle in children (Martinez-Gomez et al, 2009), higher that recommended dietary sodium intake has been referred as probably the most important dietary factor affecting BP levels in children (Falkner et al, 2010). In the meta-analysis of He and MacGregor (2006) of 10 salt reduction trials with 966 participants for an average duration of 4 weeks, it was demonstrated that a modest reduction in salt intake had a significant effect on BP in children and adolescents. A 42% reduction in salt intake reduced systolic BP by 1.2 mmHg and diastolic by 1.3 mm Hg. In three trials with infants (median duration 20 weeks) it was also shown that a salt reduction by 54% reduced the systolic pressure by 2.5 mmHg. According to the authors, these results in conjunction with other evidence provide strong support for the necessity of reduction of salt (and subsequently sodium) in children. In European and Northern American diets, it is estimated that 75 to 80 % of sodium intake comes from processed or restaurant-prepared foods (Brown et al, 2009), therefore a significant decrease in sodium intake cannot be made without avoiding or reducing the amount consumed of these foods, or without a reduction of the amount of salt added to these foods by the food manufacturers, especially in regularly consumed foods like breads and cereals. In the light of the previous data, many countries have developed their own guidelines on dietary salt intake. The United Kingdom and US guidelines recommend salt intake of less than 6 g/d (2.4 g/d of sodium) for adults. The WHO have set a worldwide target of a maximum intake of 5 g/d (2.0 g/d of sodium). In children older than 5 years, salt intake is commonly more than 6 g/d, and increases with age (He and MacGregor, 2006). The National Diet and Nutrition Survey in young people in Great Britain which was carried out in 1997 and measured salt intake, demonstrated that the average salt intake, at the age of 4 to 6 years, was 5.2 g per day for boys and 4.6 g per day for girls. With increasing age, there was an increase in salt intake, and by the age of 15 to 18 years, salt intake was 8.2 and 5.7 g per day for boys and girls, respectively (Gregory et al, 2000). In France, the main contributors to sodium intake were breads, soups, cooked pork meats, convenience foods, pastries and sugary products (Meneton et al, 2009). Finally, according to estimations salt intake in children in developed countries will raise even more due to the observed increasing trend in consuming processed and restaurant (or fast-food) foods which are generally high in sodium (Brown et al, 2009; St-Onge et al, 2003).

Table 3. Prevalence of elevated blood pressure in Greek children and adolescents

Publication	Prevalence (%)	Region of measurements/Setting	Age group	N
Papandreou et al, 2007	Boys: 27.0% pre-hypertension & 12.3% hypertension Girls: 21.2% pre-hypertension & 15.1% hypertension	Northern Greece/Schools (1 occasion)	7-15 yr	606
Angelopoulos et al, 2006	Boys: 13.7% pre-hypertension & 28.1% hypertension Girls: 13.8% pre-	Ioannina/Schools (1 occasion)	10-11 yr	312

	hypertension & 26.4% hypertension			
Tsioufis et al, 2009	5.2% hypertension	Leontio Lyceum/Office BP (2 occasions)	12-17 yr	498
Kollias et al, 2009	36.2% pre-hypertension 22.9% hypertension	Samos island/Office measurement in school (1 occasion)	12-17 yr	558

Other short-term clinical consequences of childhood obesity reported in the literature include orthopaedic problems (including fractures, musculoskeletal discomfort, impaired mobility, and lower-limb malalignment, advanced skeletal maturation), menstrual problems and early menarche, fatty liver disease, low grade systemic inflammation, nutritional deficiencies (mainly low vitamin D concentrations and iron deficiency), type 2 diabetes and hyperinsulinaemia, pulmonary disorders (obstructive sleep apnea and asthma) (Alemzadeh et al, 2008; Castro-Rodriguez et al, 2001; Han et al, 2010; Reilly et al, 2003; Nead et al, 2004; Taylor et al, 2006; Visser et al, 2001). For instance, there is fairly consistent evidence that childhood asthma is a co-morbidity of obesity, although there are researchers that debate these results and suggest that weight-related but non-asthmatic airflow limitations are perhaps being misdiagnosed as asthma in some obese children (Han et al, 2010).

1.4.2 Long-term consequences of childhood obesity

Most of the available studies investigating the association between childhood OW/OB with premature adult morbidity have focused on the later cardio-metabolic morbidity (diabetes, hypertension, ischaemic heart disease, and stroke). Fewer studies have examined associations of child or adolescent OW and OB with other adult premature mortality and morbidity from types of cancers, increased risk of later disability, asthma, and polycystic ovary syndrome symptoms. Concerning the evidence of associations between child or adolescent OW and OB, and premature mortality, most of the studies examining all cause mortality report an increased risk of premature mortality, with hazards ratios ranging from 1.4–2.9 (Engeland et al, 2003; Franks et al, 2010; Reilly & Kelly, 2011).

Evidence of associations between OW and OB in childhood and adolescence and risk of adult cardio-metabolic morbidity are provided by the systematic review performed by Reilly et al (2011). According to the review, child/adolescent OW and OB were associated significantly with increased risk of later diabetes, stroke, coronary heart disease, and hypertension. Year of birth of the study participants in the eligible studies ranged from the 1940's to 1980's, and hazard ratios ranged from 1.1 to 5.1. In a very interesting study where the data from four large follow-up studies of cardiovascular risk factors were combined, researchers aimed to determine whether a change from OW or OB during childhood to a non-obese BMI in adulthood, as compared with OW or OB during childhood that persists into adulthood, would be associated with a reduced risk of type 2 diabetes, hypertension, dyslipidemia, and carotid-artery atherosclerosis (as indicated by increased intima–media thickness of the carotid artery) (Juonala et al, 2011). Results of the analysis (with a mean length of follow-up 23 years) showed that subjects with consistently high BMI from childhood to adulthood, as compared with persons who had a normal BMI as children and were non-obese as adults, had an increased risk of type 2 diabetes (relative risk, 5.4; 95% CI, 3.4 to 8.5), hypertension (relative risk, 2.7; 95% CI, 2.2 to 3.3), elevated low-density lipoprotein cholesterol levels (relative risk, 1.8; 95% CI, 1.4 to 2.3), reduced high-density lipoprotein cholesterol levels (relative risk, 2.1; 95% CI, 1.8 to 2.5), elevated triglyceride levels (relative risk, 3.0; 95% CI, 2.4 to 3.8), and carotid-artery atherosclerosis (increased intima–media thickness of the carotid artery) (relative risk, 1.7; 95% CI, 1.4 to 2.2). However, subjects who were OW or OB during childhood but were non-obese as adults had risks of the outcomes that were similar to those of persons who had a normal BMI consistently from childhood to adulthood. Thus, this study provided evidence that there is a decrease in the risk of cardiovascular risk factors when persons who were OW or OB as children or adolescents, become non-obese as adults, raising the question whether childhood obesity should be considered as an independent risk factor for adverse health effects during adulthood.

1.5 Risk factors for the development of childhood and adolescent obesity

1.5.1 Pre-conception, pregnancy and infancy

Evidence suggests that BMI at 5 years of age is a good indicator of the future health of a child and a factor associated with adolescent obesity which in turn increases the risk of adult obesity. However although there are many studies examining early life risk factors for OW/OB, results are often mixed and inconclusive. According to many cross-sectional and longitudinal studies and meta-analyses, maternal weight status and habits affect the possibility of a child to become OW or OB. Maternal pre-pregnancy OW has been associated with childhood overweight. Hawkins et al (2009) found that the children of mothers who were overweight before pregnancy were 1.37 times (95% CI: 1.18 to 1.58) more likely to be overweight at 3 years of age than children of normal weight parents. Rooney et al (2011) found that children of mothers who were obese before pregnancy were 2.36 times (95% CI: 2.36 to 8.85) more at risk of being overweight between 9 and 14 years of age compared with children of non-obese mothers. Furthermore, weight increase during gestation has been shown to be directly associated with BMI and OB risk during adolescence (Oken et al, 2008). It has been shown that women who were overweight or who had an excessive pregnancy weight gain are more likely to have a high birth-weight baby (Robinson et al, 2012), while infant birth weight has been also identified as a potential risk factor for childhood obesity. Reilly et al (2005) found that for every 100 g increase in birth weight, the odds of overweight at 7 years of age increased by 5% (OR 1.05; 95% CI 1.03 to 1.08). In addition, Dubois and Girard (2006) found that infants who weighed ≥4000 g at birth were 2.3 times (95% CI 1.30 to 7.20) more likely to be overweight at 4.5 years of age compared with infants who weighed between 3000 and 4000 g at birth. According to the very comprehensive review of Rogers (2003) birth weight is associated with adult BMI, since a U-shaped relationship between birth weight and subsequent risk of obesity appears to apply, with the heaviest babies and the lightest being at risk of excess weight gain during subsequent childhood and adulthood (Lobstein et al, 2004b). However, it has been suggested that very low birth weight is a much weaker predictor of high adult BMI than high birth weight (Swinburn et al, 2004). Maternal smoking during pregnancy has been shown to have a significant impact on childhood overweight. According to the meta-analysis by Weng et al (2012) of seven relevant studies, it was shown that children whose mothers had smoked regularly during pregnancy were 47% more likely to be OW compared with children whose mothers had never smoked during pregnancy. It is believed that maternal smoking during pregnancy restricts fetal growth. In a large sample of Canadian children followed prospectively to ages 4–5 years, maternal smoking during pregnancy reduced birth weight, but this was followed by rapid postnatal catch-up growth and increased risk of child obesity (Dubois & Girard, 2006).

In addition to the previously mentioned factors, great attention has been paid to the rapid weight gain of infants. Studies vary on the relationship of OW/OB in infancy and their links to excess bodyweight in later childhood and adolescence, however there is nowadays a consensus that infants with a rapid growth have an increased likelihood to become overweight in childhood or adolescence (Dubois & Girard, 2006; Rooney et al, 2011). BMI normally increases from birth to about 1 year of age, declines to a nadir at about 5–7 years of age, and then begins to increase again. The age at which the nadir in BMI is reached is identified as the beginning of adiposity rebound. Rolland- Cachera et al (1984) proposed that an early age at adiposity rebound predicts adult fatness, although this theory has been criticized by other investigators (Cole TJ, 2004).

A main focus of research on the development of obesity in infancy is on breastfeeding, and on the timing of introduction and quality of weaning foods. Several recent reviews and meta-analyses addressed the effects of breastfeeding on later obesity. These reviews generally conclude that breastfeeding offers weak to moderate protection against obesity, with dose response relationships indicating a decreased obesity risk with longer duration of breastfeeding (Adair LS, 2008). However, the original studies vary widely with respect to how well they control for confounding factors, particularly maternal smoking, parental obesity and socio-economic status. Weng et al (2012) in their meta-analysis compared children who were ‘ever breastfed’, including those exclusively breastfed, ever breastfed or fed a mixture of formula and breast milk during the first year of life, with children who never breastfed and were exclusively formula-fed, as the reference group. The results showed that ever breastfeeding in the first year of life significantly decreased the odds of overweight in childhood by 15% (Adjusted OR 0.85; 95% CI 0.74 to 0.99; n=10 studies). Similarly, in the review of Owen et al (2005) when they only considered studies that adjusted for three potential confounding factors (i.e. parental obesity, maternal smoking, and social class), the inverse association between breastfeeding and obesity was reduced but not abolished (0.93, 95% CI: 0.88–0.99). The mechanisms by which breastfeeding affects the risk of being overweight are still unclear. Compared with formula-fed neonates, breastfeeding results in a lower body weight gain during the neonatal period caused by a lower mean caloric intake, and lower protein intake which results into lower insulin and insulin-like growth factor-1 (IGF-1) plasma levels (Moreno & Rodriguez, 2007).

While the effects of breastfeeding has been extensively studied, there are fewer large longitudinal studies examining the association of the timing or types of weaning foods with infant overweight. Early introduction of solid foods is a concern and is considered a risk factor for later obesity because such foods may increase the energy density of the diet relative to breast or formula feeding alone (Adair LS, 2008). Hawkins et al (2009) found that infants given solid foods before 4 months were 1.12 times (95% CI: 1.02 to 1.23) more likely to be overweight at 3 years of age compared with infants who were given solid foods after 4 months. Huh et al (2011) found that formula-fed infants given solid foods before 4 months were 6.3 times (95% CI: 2.3 to 16.9) more likely to be overweight at 3 years of age compared with infants who were given solid foods between 4 and 5 months. However it should be noted that there are studies showing no association between early introduction of solid foods and OW or OB in children.

Data for the Greek childhood population come from cross-sectional studies. Panagiotakos et al (2008), reported that compared to non-breast-fed, boys who were breast-fed for >3 months had 70% lower likelihood of being overweight or obese and breast-fed girls had 80% lower odds. Additionally, excessive birth weight (>3500 g) increased by 2.5-fold the likelihood of being overweight or obese only in girls ($P < 0.05$). Moschonis et al (2008) in a representative sample of 1-5 years old preschoolers showed that children born large for gestational age (≥90th percentile) were 4.59 and 2.19 times more likely for being overweight at 6 and 12 months of age, respectively, than children born appropriate for gestational age. On the other hand, children that were exclusively breastfed were 0.49 and 0.54 times less likely for being OW at 6 and 12 months of age, respectively, than children that were exclusively formula fed. Furthermore, 3- to 5-year-old children born from mothers who were both active and passive smokers during pregnancy were 1.79 times more likely of being overweight compared to children born from nonsmoking mothers. In addition, under the context of the same study (GENESIS study), it was revealed that children with a rapid weight gain in infancy were 1.9 (95% CI: 1.3 to 2.7) times more likely to be overweight (Manios et al, 2010). Finally, a recent study in children 9-13 years indicated certain perinatal factors (maternal pre-pregnancy obesity, maternal smoking at pregnancy, rapid infant weight gain and late introduction of solid foods at weaning) and parental characteristics as important risk factors for adolescence OW and OB, demonstrating the multifactorial nature of the problem (Birbilis et al, 2013).

1.5.2 Dietary risk factors

Obesity is the result of an energy imbalance in a susceptible subject. Energy balance homeostasis is regulated by a complex network of neurohormonal and metabolic processes, and overweight appears when persistent positive energy imbalances occur for long periods of time. Dietary and meal habits have been the subject of investigation for a very large number of studies during the last decades. The ideal method to investigate dietary risk factors for the development of childhood and adolescence OB would be longitudinal studies as they give us the possibility to control for confounding factors and to evaluate the effect of a specific factor over time, when the children become obese (Moreno & Rodriguez, 2007).

Many behaviours that affect the energy balance and/or the satiety feeling in children have been identified as factors that protect against or promote the prevalence of childhood OW/OB. Breakfast skipping is one of the mostly referred habits associated with increased body mass index. According to cross-sectional studies, obese children eat less energy at breakfast, miss breakfast more frequently and consume a higher percentage of energy at mid-day snacks and dinner (Deshmukh-Taskar et al, 2010; Kontogianni et al, 2010; Moreno et al, 2005; Moschonis et al, 2013). Besides the frequency of breakfast consumption, the type of breakfast has also been shown to affect the relationship between breakfast and OW/OB, since it has been shown that consumption of breakfast cereals is inversely associated with the prevalence of OW and OB in preadolescents and adolescents (Kosti et al, 2008). Furthermore, the habit of family breakfast has been associated with a more regular intake in the morning (Moreno & Rodriguez, 2007). In the ENERGY study, a cross-sectional, school-based survey across eight European countries, it was shown that children who ate breakfast had 40% less odds of being overweight than those who did not (Vik et al, 2013).

Eating frequency (i.e., the total number of meals/eating episodes consumed on a daily basis) in relation with the BMI status of children and adolescents is another topic that has also been investigated in a recent meta-analysis of Kaisari et al (2013). According to the results, higher eating frequency was associated with lower BMI status, and specifically children and adolescents who had a higher number of eating episodes per day had 22% lower probabilities of being OW or OB compared with those who had fewer episodes. Nevertheless, this inverse association was evident only in boys, a result which agrees with a previous cross-sectional study in adolescents showing that the daily frequency of eating episodes was associated with obesity indices in boys, but not in girls (Kosti et al, 2007). The protective effect of higher number of meals and snacks per day has also been supported by other studies (Kontogianni et al, 2010; Moschonis et al, 2013; Toschke et al, 2005). However, since there is no general agreement on how to define snacking it is probably best to consider the content of snack foods and the increased eating frequency as separate issues. Consumption of snacks between meals and the contribution of snacking to total daily energy and fat intake have increased among children and adolescents during the last decade, as well as the energy density of snacks (Moreno & Rodriguez, 2007). A longitudinal study showed that snacking, when associated with a daily sedentary activity such as television viewing, had a significant correlation with body composition changes in girls (Francis et al, 2003), although these results have not been confirmed by other studies. Furthermore, Yannakoulia et al (2004), in a representative study of Greek school-aged adolescents showed that the more the hours spent in front of the TV, the higher the percentage of students reporting to consume sodas, crisps, cakes and pastries, sweets and chocolates at least once a day, whereas the consumption of fruits was less frequent. In the light of the reported studies it has been suggested that it is prudent to promote a regular meal pattern with 5 meals per day with adequate nutrients density to children and their families, being cautious about the energy density of snack foods (Koletzko & Toschke, 2010).

Food portion size in relation with the frequency of eating outside home has also been the subject of discussion in relation to the high OW and OB prevalence in childhood and adolescents populations. There are data indicating that in western countries the frequency of eating food prepared outside the home is increasing while the frequency and amount of foods prepared at home are decreasing (Swinburn et al, 2004). Reports coming mainly from the US show that food prepared away from home is higher in total energy, total fat, saturated fat, cholesterol and sodium, but contains less fiber and calcium and is overall of poorer nutritional quality than home prepared food (Swinburn et al, 2004). Together with the increased frequency of eating outside home, nowadays, the portion sizes of some food items (snacks, soft drinks, french fries, hamburgers) are on the increase and all these are in parallel with the rise in the prevalence of obesity. It has been shown that children's energy intake increases when larger portions are offered and that children fail to reduce consumption by satiety signals that compensate for the feeling of 'fullness'. Moreover, children are more influenced by portion size as they became older (Ello-Martin et al, 2005; Rolls et al, 2000).

A quite large body of literature has examined the relation between sugar-sweetened beverages (SSBs) and BMI status in children and adolescents. SSBs include but are not limited to sodas, fruit drinks, and sports and energy drinks, and have been at the forefront of obesity-related policy debates as SSB consumption has been positively associated with increased body weight and risk of obesity (Han & Powell, 2013; Malik et al, 2006). Caloric intake from SSBs has been reported to be increased by 135% between 1977 and 2001 in all age groups. Particularly, adolescents and young adults are reported to consume more SSBs than younger children and older adults. The majority of children and adolescents (88%) have been reported to consume SSBs on a given day to the extent of 271 kcal per day, on average (Han & Powell, 2013; Nielsen et al, 2002; Wang et al, 2008). According to the studies of Han et al (2013) and Kit et al (2013) the overall consumption of SSBs in the US fell between 1999-2010, although the level of non traditional (i.e. soda drinks) rose. Additionally, the prevalence of heavy total SSB consumption (≥500 kcal/day) increased among children (4% to 5%) but it decreased among adolescents (22% to 16%). Irrespectively, of the trends of consumption, recent systematic reviews and meta-analyses provide evidence that SSBs consumption is associated with weight gain in both children and adolescents, mainly through their high added-sugar content, low satiety, and an incomplete compensatory reduction in energy intake at subsequent meals after intake of liquid calories (Malik et al, 2013).

1.5.3 Physical activity and sedentary lifestyle

The health benefits of a physically active lifestyle in childhood are undisputed and include cardiovascular, musculoskeletal, psychosocial and cognitive advantages (Reilly et al, 2008). Since the increased prevalence of OW and OB in youth is believed to be the result of increased energy intake and reduced energy expenditure, or both, it is absolutely justified to study the relationship between physical activity and sedentary lifestyle and the risk of developing childhood OW or OB. Many organizations have developed recommendations regarding the amount of time that children and adolescents should participate in physical activities. Canada's Physical Activity Guides for Children and Youth recommend that children and adolescents should accumulate at least 90 minutes of moderate to vigorous-intensity physical activity per day (Government of Canada, 2011), whereas American guidelines recommend that children and adolescents should participate in at least 60 minutes of moderate-intensity physical activity most days of the week, preferably daily (US Department of Health and Human Services, 2005).

Sedentary behavior is also emerging as an important component of obesity and should be recognized as behavior that is distinct from physical activity (Wong & Leatherdale, 2009). Sedentary behavior has been described by a complexity of sedentary actions like watching TV, playing video games, using the computer, reading, and doing homework and each may have different implications for obesity. Leatherdale & Wong (2008) in an attempt to estimate the different types of sedentary behaviors in 9-12 years old students, found that children are highly involved in screen-based sedentary behaviors, but spend a limited time on more productive sedentary behaviors, like reading and homework. National organizations have developed recommendations regarding the amount of time that children and adolescents should be sedentary. Canada's Physical Activity Guides for Children and Youth recommend that children and adolescents decrease by 90 minutes per day the amount of time spent in nonactive activities, such as watching television, watching videos, and sitting at a computer (Government of Canada, 2011), and the American Academy of Pediatrics recommends that children's total media time (with entertainment media) be limited to no more than 2 hours per day (Barlow et al, 2007).

Studies of physical activity and energy expenditure have measured the incidence or prevalence of specific physical activities as indicators of raised energy expenditure, or levels of inactivity, or sedentary behavior, as indicators of low energy expenditure. A review of longitudinal observational studies published between 2000 and 2009 aiming at synthesizing the prospective associations between measured physical activity and change in adiposity in children, adolescents and adults concluded that there was no evidence of an association between time spent in objectively measured physical activity and changes in measures of childhood obesity. Riddoch et al (2009) followed over 4000 children from age 11 to 13, and observed a negative association between objectively measured moderate-to-vigorous physical activity (MVPA) and changes in fat mass and BMI. Similarly, a negative association between objectively measured MVPA and change in BMI was reported in a study that followed 280 children from age 8 to 9 years (Fischer et al, 2011). Mitchell et al (2013) in a study aiming to determine whether time spent in objectively measured physical activity (i.e. accelerometers worn for 7 days) is associated with change in body mass index (BMI) from ages 9 to 15, found that time spent in MVPA was negatively associated with change in BMI from age 9 to 15, particularly among children in the upper tail of the BMI distribution. In addition, it was shown that for both boys and girls, time spent in MVPA declined with increasing age, a trend also seen in younger children as well (Taylor et al, 2013).

Information regarding the physical activity levels of Greek school children has been provided from the ENERGY ("EuropeaN Energy balance Research to prevent excessive weight Gain among Youth"-project) study (Verloigne et al, 2013). The aim was to objectively assess the levels of sedentary time, low physical activity and MVPA in 10- to 12-year-old children across five European countries using accelerometers, and to present the differences between them. Concerning country characteristics, Greek boys were more sedentary (510 minutes per day) than all other boys, as well as Greek girls (526 minutes per day). In addition, only 4.6% of the girls of the whole study group of the current study met the recommendation of at least 60 minutes MVPA per day, compared to 16.8% of the boys. None of the Greek girls met the MVPA recommendations, while Greek boys had the lowest percentage of meeting the recommendations. As it was highlighted by the authors, possible explanations for differences observed between countries could be the variation in the national policy of promoting physical activity in sports, as well as the differences in hours of physical education provided in schools (Greek schools provide two hours per week). Regardless of the differences between countries, the former study provided evidence that very few boys and girls across Europe met the recommendations of MVPA per day and that a large proportion probably exceeds the guideline of no more than 2 hours of screen time per day. Under the context of the ENERGY study, in another work, children were grouped based on their MVPA and sedentary time, and differences in BMI between them were examined. The comparison between subgroups showed that engagement in more MVPA and less sedentary time is associated with a more favorable weight status among 10- to 12-year-old girls. Among boys, MVPA seemed most important for weight status, while sedentary time appears to be less relevant (De Bourdeaudhuij et al, 2013).

Other studies from Greek childhood populations confirm the inverse association between physical activity levels (especially MVPA, assessed with questionnaires) or physical fitness and BMI in children, obviously explained by the increased energy expenditure (Antonogeorgos et al, 2010; Moschonis et al. 2013; Tambalis et al, 2011). In addition, there are signs that children living in rural areas have higher levels of PA and more frequently met physical activity guidelines than their urban counterparts (Tambalis et al, 2013). However, there are also reports showing no association between physical activity levels and BMI (Kontogianni et al. 2008; Tambalis et al, 2013). This inconsistency could be partially attributed to the assessment tools used in the studies. Another convincing etiology, however, is the one proposed by Wong & Leatherdale (2009), where the authors highlight the fact that the relationship between physical activity and BMI may be moderated by sedentary activity. Thus, when researchers try to investigate the relationship between physical activity and BMI, they should also consider to assess the type and level of physical inactivity. A previous study revealed that some youngsters engaged in many hours of sport participation per week but, at the same time, watched TV or played on the computer for more than four hours per day (Biddle et al, 2004). It is therefore evident that physical and sedentary time should be regarded as two different behaviors.

Screen time (i.e. time spent on sedentary activities and more specifically on watching television/DVD/movies and/or recreational usage of games consoles/computer) is considered the most influential sedentary behavior affecting the likelihood of OW and OB development. Most of the research is related to television (TV) viewing, since there is a general agreement that increased TV viewing promotes OW and OB in children and adolescents. Studies form Greek preschoolers have demonstrated that almost 30% exceed the current recommendation of screen viewing, and that children spending 2 or more hours per day watching TV seem to have higher energy intake and increased consumption of high-fat and high-sugar foods (Kourlaba et al, 2009; Manios et al, 2009).

Several potential mechanisms have been proposed to explain the relationship between TV watching and OB, including increased energy intake, less time available for physical activity, increased sedentary behavior, less sleep duration, and the influence of TV advertising of foods and beverages that targets children and increases the purchase and consumption of energy dense foods (Dietz & Gortmaker, 1985; Pate et al, 2011; Lobstein & Dibb, 2005; Magee et al, 2014). Thus, the relationship between TV watching and obesity may not only be due to the sedentary activity as such, but may also be partly associated with eating behaviors in front of the TV. A prospective study by Gortmaker et al (1996) monitored a cohort of children aged 10–15 years during a 4-year period. The results showed a strong dose–response relationship between hours of television viewing and the prevalence of overweight at the end of the period, even after adjusting for several confounders. Those children watching television the most (over 5 hours per day) were five times as likely to be overweight than those watching fewer than 2 hours per day. The amount of time spent viewing TV has been shown to be determined by various factors. According to recent reports, having TV in the children bedroom is positively associated with measures of adiposity, mediated by TV viewing time (Cameron et al. 2013). The presence of parental limits on TV viewing time has been shown to reduce children's viewing time, while increased time of parental TV viewing is positively associated with children's TV viewing time (Lobstein et al, 2004b).

Observational studies have reported positive associations between prevalence of TV viewing during meals and BMI. Both watching TV and eating while watching TV have been found to be positively and independently associated with OW (Dubois et al, 2008), suggesting that both sedentary behaviors as well as calories intake while watching TV contribute to OW in children, and poorer diet quality (Liang et al, 2009). Under the context of the ENERGY project, where data regarding dietary habits and associates were also included from Greek childhood population, showed that children who never watched TV at lunch and dinner had lower odds of being overweight compared to those who did (Vik et al, 2013).

1.5.4 Parental and family influences

Both maternal and paternal BMI have been shown to be significant predictors for childhood and adolescence OW/OB status. This influence of parental obesity has been shown in many studies (Padez et al, 2005; Savva et al, 2002; Panagiotakos et al, 2008; Kosti et al, 2008) and may be explained by genetic, as well as environmental and behavioural factors since parents play a direct role in shaping children’s eating and physical activity habits (Reiily et al, 2005; Wardlet et al, 2008). In a study performed in Greece and particularly in Crete it was shown that parental BMI status had the greater effect on children’s BMI classification, as children with two obese parents had 11.6 times higher likelihood of being OW or OB than their peers with normal weight parents (Manios et al, 2010). These findings were confirmed by another study of preschool Greek children, showing that children with one obese parent had 91% greater odds for being overweight compared to those with no obese parent, while the likelihood for being overweight was 2.38 times greater for children with two obese parents (Manios et al 2007).

Children learn about eating not only through their own experiences but also by watching others and especially their parents who act as role models. A growing body of research demonstrates similarities between parents’ and children’s food acceptance, preferences and intake (Patrick & Nicklas, 2005). Their role in shaping children's eating and activity habits is direct since they are primarily responsible for food procurement, and meal preparation and can be a strong positive influence towards more healthy food choices and lifestyle, acting as good dietary role models or on the contrary a strong negative influence. As a consequence, an eating practice that has been proved to protect against obesity risk, is the habit of frequent family meals. A significant reduction of the odds of being OW (by 12%) and eating unhealthy (by 20%) was reported in the meta-analysis of Hammons and Fiese (2011), for children and adolescents who had family meals 3 or more times per week, compared with those that did not. Although the specific mechanisms of how family mealtimes influence nutritional habits and protect against childhood overweight are not entirely revealed, it has been postulated that family meals promote social interaction and allow parents to act as dietary role models and control both the quality and quantity of their child's diet as well as recognize early signs of disordered eating (Adamo & Brett, 2013; Hammons & Fiese, 2011; Scaglioni et al, 2008). Taveras et al (2005) reported that the frequency of eating family dinner was inversely associated with overweight prevalence in adolescents at baseline but not with the likelihood of becoming overweight in longitudinal analyses. Furthermore, it has been observed that the family breakfast is associated with a regular intake in the morning, while the frequency of family dinner is inversely related to fried foods and soda drinks consumption (Moreno & Rodriguez, 2007; Gillman et al, 2000). Feldman et al (2007) in a cross-sectional study aiming to examine associations between watching television during family meals and dietary intake among adolescents observed that adolescents who watched television had lower intakes of vegetables, calcium-rich food, and grains and higher intakes of soft drinks compared to adolescents not watching television during family meals. However, watching television during family meals was still associated with a more healthful diet than not eating regular family meals.

An extremely influential risk factor is the parental misperception of the children's body weight status and the inability to recognise overweight or obesity. There is a growing body of evidence showing that a significant proportion of parents fail to recognise OW status of their child (Rietmeijer-Mentink et al, 2013), probably because of a lack of awareness of what overweight means or unwillingness to admit the problem (Maynard et al, 2003). Irrespective of the cause, if parents cannot recognize the problem of OW they do not also realize the health consequences, do not take actions to treat the situation and improve the children's diet quality. A study performed in Greek preschool children aiming to evaluate the maternal misclassification rate of child weight status, demonstrated that almost 38% of mothers underestimated their child's weight status, while the frequency of underestimation was much higher among 'at risk of being overweight' and 'overweight' children (Manios et al, 2009). Furthermore, Etelson et al (2003) conducted a study among children aged 4 to 8 years and found that only 10.5% of OW children's parents perceived their child's weight accurately. Parents of preschool children have also been found to frequently over-estimate how much food their children require and to promote eating after the child has indicated that they are full (Mrdjenovic & Levitsky, 2005). In addition, observational studies have shown that higher levels of maternal nutrition knowledge and children's weight consciousness are associated with higher fruit and fiber intakes and lower fat intake by children (Clark et al, 2007).

Besides diet, the family is also considered as one of the most important settings for shaping children's physical activity levels. Parents may act as role models through their physical activity habits and engagement in sports, co-participation with children, parental support through accompanying children to sports training and events, providing financial support for activity and generally encouraging physical activity (Cleland et al, 2010; Cleland et al, 2011; Jago et al, 2011). In a study attempting to identify associations between aspects of the family environment and 10–12 year-old children's weekly participation in sport, it was shown that physical activity equipment items in the home, parental provision of financial, logistic and emotional support, and parental modeling were all positively associated with children's participation in ≥ 30 min/week of sport (Timperio et al, 2013). The influence of family environment had both a direct and a mediated (via children's physical activity attitudes, beliefs, perceived behavioral control and enjoyment) effect on children's sport participation. Thus, it was concluded that future interventions should include strategies to change aspects of the family environment and to be more supportive of children's physical activity or sport, as this is likely to have a direct effect on sports participation.

Since childhood obesity etiology involves a complexity of genetic, behavioral and cultural factors (Seagle et al. 2009), parents play a central role in all of them. In addition, parental socio-economic status has been shown to influence most of the aforementioned protective or aggravating parameters that affect the likelihood of childhood obesity. The mostly studied socio-economic indices are parental education, parental occupation and profession, family income, neighborhood level socio-economic indicators, and other socio-economic status (SES) measures like the ownership of houses, cars, origin/nationality, parental marital status etc. Although the relationship between obesity and SES is complex, in general, it has been shown that in low income countries obesity is more prevalent in high SES individuals but in affluent countries, it is more prevalent in low SES individuals (Swinburn et al, 2004; Stamatakis et al, 2010). Increase in obesity prevalence can be also seen in some countries that undergo a period of economic transition (Monteiro et al, 2001). In developed countries, it seems that the relationship may be bi-directional (i.e. low SES promotes obesity and obesity promotes low SES) although both obesity and low SES are being independently influenced by other common factors such as the level of education. The mechanisms by which high SES in developed countries provides some protection against childhood (and all family members) obesity have not been well identified and are likely to include behaviors such as better eating practices, increased levels of recreational activity, living in less obesogenic environments with greater opportunities for healthy eating and physical activity, or even better school and educational settings, or better understanding and adaptation of public health initiatives and recommendations to tackle OW and OB (Lamerz et al, 2005; Lioret et al, 2009; Patrick et al, 2005; Stamatakis et al, 2010; van Jaarsveld et al, 2007). Neighborhood level socio-economic indicators and the correlation between geographic area of residence and OB, are of particular interest in identifying the social determinants of OB, especially factors that may be modifiable. Factors likely associated to SES that may explain how the environmental variables create “obesogenic environments” include low walkability, lack of recreation sites for physical activity, lack of grocery stores offering affordable fresh fruits and vegetables, and higher density of fast food establishments (Long et al, 2007; Swinburn et al, 2004).

A review of cross-sectional studies published between 1990 and 2005 from western developed countries found that socioeconomic status was inversely associated with school-age children’s OW or OB levels in 42% of the reviewed studies, with the rest of the studies reporting a mixture of inverse or no associations (Shrewsbury & Wardle, 2008). The choice of SES variables included in the studies obviously influenced these relationships with the evidence when using family income as a possible variable explaining childhood obesity being less conclusive, while parental education showed the most consistent inverse relationship with children’s OB risk. Data from Greek childhood and adolescent populations confirm the relationship of SES and childhood OW/OB. Manios et al (2007) reported that the prevalence of overweight in Greek preschoolers is very high and is strongly related to parental overweight, and that maternal and paternal educational level, an indirect indicator of SES, was not found to influence the risk of overweight. In another study performed in children 9-13 years old, 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 (Moschonis et al, 2010). In addition, Kontogianni et al (2010) in a representative cross-sectional sample of children and adolescents, besides finding that a lifestyle pattern characterized by higher eating frequency, breakfast consumption, and higher adherence to a Mediterranean-style diet was negatively associated with BMI, also found that parental education level was negatively associated with children's BMI. Accordingly, Antonogeorgos et al (2013) showed that parental education status seems to play a mediating role in the beneficial effect of Mediterranean diet on children's obesity status, while on the contrary Manios et al (2010) in a representative sample of the island of Crete reported that higher paternal educational level was found to increase the risk for children’s OW and OB. According to the authors, this opposite effect could be partially explained by the fact that paternal educational level largely reflects the socioeconomic status of the household in towns and rural areas in Crete, and for the traditional Greek patriarchic household, as is the case in Crete, improvement in the socioeconomic conditions resulted in an increase in body weight in Greek school children in the 20th century (Papadimitriou et al 2007). Finally, Birbilis et al (2013) in a study among 9–13-year-old schoolchildren, in four Greek counties, showed that among other important factors non-Greek nationality, high parental education and high father’s age were found to be negatively associated with childhood OB.

2. Scope of the current PhD thesis

The aims and objectives of the current PhD thesis are: a) to provide national data on overweight and obesity prevalence in a representative sample of primary schoolchildren aged 10-12 years old, b) to identify those socio-economic, demographic factors, as well as dietary and physical activity habits and familial characteristics that are associated with childhood and preadolescent overweight and obesity, c) to identify lifestyle and dietary patterns that are associated with elevated blood pressure levels and dietary sodium intake.

The specific aims of each scientific paper supporting this PhD thesis were:

Paper I: To provide current national data on overweight and obesity prevalence in preadolescent schoolchildren (aged 10–12 years old) in Greece and, additionally, to evaluate the quality of children's diet by assessing the degree of adherence to the Mediterranean diet and its association with the obesity rates.

Paper II: To identify possible socio-economic and demographic factors that are associated with the very high childhood overweight and obesity rates at the national level.

Paper III: To investigate the perinatal and family factors that are related to the prevalence of children's overweight/obesity.

Paper IV: To identify those dietary and physical activity habits and behaviors, as well as parental perceptions and influences that are associated with childhood OW/OB, and to recognize the most important parameters.

Paper V: To identify children misreporters (under- and over-reporters), evaluate anthropometric, lifestyle and parental characteristics that are related with the prevalence of misreporting, and to assess psychological parameters that are associated with under- and over-reporting.

Paper VI: To assess the daily dietary sodium intake (excluding table salt and salt added during cooking) of 10–12 years old Greek children, within the context of the Mediterranean diet pattern.

Paper VII: To identify specific lifestyle and dietary patterns associated with elevated blood pressure levels in children.

3. Presentation of papers

PAPER I

Farajian P, Risvas G, Karasouli K, Pounis GD, Kastorini CM, Panagiotakos DB, Zampelas A. Very high childhood obesity prevalence and low adherence rates to the Mediterranean diet in Greek children: The GRECO study. *Atherosclerosis* 2011; 217:525-30.

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Very high childhood obesity prevalence and low adherence rates to the Mediterranean diet in Greek children: The GRECO study

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ABSTRACT

Objective: In order to provide estimates of overweight and obesity among Greek schoolchildren, and the adherence rates to the Mediterranean diet (MD), a nationwide survey was performed among fifth and sixth grade students aged 10–12 years old.
Methods: A stratified sampling in 10 regions of the country was applied to voluntarily enroll a representative sample of 4786 children. Children were weighed and measured and completed a semi-quantitative food frequency questionnaire with a supplementary section for the assessment of dietary aspects and physical activity levels. Additionally, the KIDMED index was used to evaluate the degree of adherence to the MD.
Results: According to the IOTF cut-offs, overweight (OW) and obesity (OB) prevalence among boys was 29.9% and 12.9%, while in girls 29.2% and 10.6%, respectively. Only 4.3% of the children had an optimal KIDMED score. KIDMED score did not differ between boys and girls and no differences were detected between normal weight and OW and OB children. However, children from semi-urban or rural regions had higher score. Furthermore, children with higher KIDMED score reported following a healthier diet and having higher physical activity levels.
Conclusion: The prevalence of childhood obesity in Greece is the highest ever reported together with low adherence rates to the dietary patterns of the MD. Current findings suggest an increased risk for even higher rates of obesity in adolescence and adulthood in the near future. Taking into account that children are also abandoning the traditional cardio-protective MD, the increased risk for future adverse health consequences seems evident.

1. Introduction

Several studies have focused on the short-term and long-term consequences of childhood obesity, and high body mass index (BMI) levels have consistently been found to be associated with cardiovascular disease risk factors such as insulin resistance, dyslipidemia, and increased blood pressure [1]. An important criterion of the validity of childhood BMI is its relation to adult obesity, and almost all longitudinal studies have found that children with high BMI levels are more likely to become obese adults than are thinner children [2,3]. Due to the tracking of BMI from childhood to adulthood, there is strong evidence that childhood obesity is associated with adult cardiovascular disease risk. In addition, it has been suggested that being underweight during childhood and overweight in adulthood also increases the risk for raised blood pressure during adulthood [4].

According to data from previous European cross-sectional and epidemiological studies, childhood obesity is an escalating health problem particularly in countries surrounding the Mediterranean sea that show very high overweight (OW) and obesity (OB) prevalence rates [5]. Since the early 1960s when the first results of the Seven Countries Study established that the traditional Mediterranean dietary pattern, as followed in Crete, was associated with lower ischemic heart disease [6], several studies have demonstrated that greater adherence to the Mediterranean diet is associated with a significant reduction in total mortality, improvement in longevity and lower incidence of atherosclerosis, coronary heart disease, metabolic syndrome and inflammation [7–9]. Yet, the fact that surveys conducted at local or regional level in Greece have noted that childhood obesity rates are among the highest in Europe [5,10], seems to go against the conventional belief of the population in Greece and the rest of the Mediterranean regions that since the

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Fig. 1. The prefectures in Greece included in the study.

Mediterranean diet is healthy it should also protect against OW and OB. In fact, there are evidence that the adult and children Mediterranean population are gradually abandoning the traditional dietary pattern [11]. However data on how this nutrition transition affects OW and OB rates are scarce and it is not clear whether the adherence to the Mediterranean diet has any protective effect on the childhood obesity problem.

The aim of the present paper from the Greek Childhood Obesity (GRECO) study was to provide current national data on overweight and obesity prevalence in preadolescent schoolchildren (aged 10–12 years old) in Greece and, additionally, to evaluate the quality of children's diet by assessing the degree of adherence to the Mediterranean diet and its association with the obesity rates.

2. Methods and procedures

2.1. Sampling procedure

The study was carried out from October to May 2009. A stratified sampling scheme by age and sex group, based on the population distribution (National Statistical Services, 2001 census), in 10 regions of the whole country (i.e., Attica, Macedonia, Peloponnisos, Sterea Ellada & Evia, Ipeiros, Thessalia, Thrace, Aegean islands, Ionian islands and Crete) was used to obtain a representative sample of 5000 children. The number of children had been pre-specified using statistical power calculations in order to achieve a 85% power at 5% type I error when evaluating odds ratios equal to 1.10. Thus, using also the official catalogues provided by the regional directorates of primary education, a total of 4786 fifth and sixth grade schoolchildren with a mean age of 10.9 ± 0.75 years old (49.3% males and 50.7% females) were finally voluntarily enrolled (participation rate 95%). The number of schools that agreed to participate in the study was 117 from all over the country (10 regions and 14 prefectures) (Fig. 1). The prefectures were grouped based on their population in "Large urban areas" with a population size greater than 1,000,000; "Urban and Semi-urban Areas" with a population size ranging from 10,000 to 100,000 inhabitants. Finally, 52.0% and 48.0% of the sample came from large urban and urban and semi-urban areas, respectively.

The research and all the means used in the study were approved by the Hellenic Ministry of Education (Department of Primary Education) as the law provides in Greece for any studies conducted in the school environment during formal school hours, and the Agricultural University of Athens Research Committee.

2.2. Anthropometry and obesity and underweight definition

The measurements were conducted by investigators and stuff of the Unit of Human Nutrition of the Agricultural University of Athens. Investigators followed a series of planning meetings and were trained in survey methods during training sessions that included practical experience in weighing and measuring techniques. All study sites used the same measuring equipment and procedures and in each class the investigators' team consisted of at least two people.

All measurements were performed during morning hours. Body weight was recorded to the nearest 100 g with the use of a digital scale (Tanita TBF 300) and with subjects standing without shoes in light clothing. Standing height was measured using a portable stadiometer (Leicester height-measure) to the nearest 0.1 cm without shoes, with the head positioned according to the Frankfort plane. Body mass index (BMI) was calculated by dividing weight (kg) by standing height squared (m^2). Waist and hip circumferences were measured to the nearest 0.1 cm with the use of a non-elastic tape (Seca, Germany) and with the subject at a standing position. Waist circumference was measured at the end of a gentle expiration after placing the measuring tape in a horizontal plane around the trunk, at the midway between the lower rib margin and the iliac crest. Hip circumference was measured at the point yielding the maximum circumference over the buttocks. Waist to hip (W/Hp) and waist to height (W/Ht) ratios were also calculated. Percentage of body fat (%BF) and body fat mass were estimated by the foot to foot impendence method (Tanita TBF 300) with children standing barefoot.

Obesity and overweight among children were evaluated using the IOTF (International Obesity Task Force) age- and gender-specific body mass index (BMI) cut-off criteria [12]. Underweight for children was defined using the international cut-off points for BMI for thinness grades 1, 2 and 3 by gender defined to pass through BMI of 16, 17 and 18.5 respectively, at age 18 [13].

2.3. Dietary and eating behaviour assessment

Dietary assessment was based on a validated self-reported, semi-quantitative food frequency questionnaire (FFQ), consisted of 48 food items commonly used in the local Greek cuisine [14]. All participants were asked about their usual frequency of consumption of the food items (average over the last year) with the following response categories: Everyday, 3–6 times per week, 2 times per week, once a week, 1–2 times per month and seldom/never. Participants were also asked to quantify the portion of the food item they usually consumed, therefore standard size pictures of the food portions were also illustrated in the questionnaire for each of the food items in order to help the children to visualise the regular portion. Besides the basic food items, the questionnaire included 11 more supplementary questions assessing the type of the foods consumed (such as whole wheat vs. white bread, brown vs. white rice, low-fat dairy products vs. full-fat, and sugar-free vs. regular soft drinks).

2.4. Assessment of Mediterranean diet patterns

The KIDMED index (Mediterranean Diet Quality Index for children and adolescents) was used to evaluate the degree of adherence to the Mediterranean diet [15]. The KIDMED index was developed in an attempt to combine the Mediterranean diet (MD) guidelines for adults as well as the general dietary guidelines for children in a single index. It is based on the principles sustaining the Mediterranean dietary pattern as well as on those that undermine it. The index comprises of 16 yes or no questions. The total score ranges from −4 to 12 and is classified into 3 levels: ≥8, good adherence to the principles of the MD; 4–7, average adherence to the principles of the MD; and ≤3, very low diet quality in relation to the principles of the MD.

2.5. Physical activity assessment

All participants were asked to complete the Physical Activity Questionnaire for Older Children (PAQ-C) [16]. The instrument is designed for use in older children (ages 8–14 years) and consists of nine questions structured to discern moderate through vigorous physical activity (MVPA) during the last 7 d. The summary score for the PAQ-C is the average of the sum of the nine questions and it is designed to be used during the school year, rather than summer vacation or holiday periods (theoretical range 1–5).

2.6. Statistical analysis

Continuous variables are presented as mean ± SD, whereas categorical variables are presented as absolute and relative frequencies. Normality of variables' distribution was tested graphically using the P–P plots. The Student's *t*-test and one-way ANOVA, with Bonferroni correction to account for the inflation of type-I error due to multiple comparisons made, were applied to evaluate differences in mean values of normally distributed data. Associations between categorical variables were tested by contingency tables and chi-square test. In addition, discriminant analysis with the calculation of Wilk's lambda (theoretical range 0–1, the lower the better discriminating ability), was also applied to evaluate and hierarchy the food groups included in the KIDMED score, as regards the classification of children to normal weight and overweight/obese. All reported *P*-values are based on two-sided tests and compared with a significance level of 5%. SPSS 18.0 software (Statistical Package for Social Sciences, Chicago, IL, USA) was used for all statistical calculations.

3. Results

According to the IOTF cut-offs, the overall prevalence of childhood overweight (OW) was 29.5% and of obesity (OB) was 11.7%. The gender-specific prevalence for BMI categories is presented in Table 1. The prevalence of overweight and obesity was higher in boys than girls (χ^2 = 7.37, P = 0.02) and the same result was shown after combining overweight and obese (OW/OB) subjects into one category (χ^2 = 4.40, P = 0.04). Furthermore, no differences were observed in the prevalence of OW, OB, or combined OW/OB in the overall sample and in both genders according to residence in large urban or semi-urban areas (P for all > 0.05). Additionally, no differences were found between different age-groups (10, 11 and 12 years old) concerning OW and OB prevalence, for both genders and the overall sample. Concerning the prevalence of thinness (including thinness grades 1, 2 and 3), it was found to be significantly higher in girls than boys (χ^2 = 8.3, P = 0.04).

Table 1
Prevalence of overweight, obesity and underweight in n = 4786 Greek 10–12 years old children according to the criteria suggested by IOTF.

	Overweight	Obese	Underweight
Boys (%)	29.9[a] (28.3, 30.9)	12.9[a] (11.5, 13.3)	3.3 (2.52, 3.48)
Girls (%)	29.2 (27.02, 29.58)	10.6 (9.15, 10.85)	5.0[a] (4.36, 5.58)
Total (%)	29.5 (27.7, 30.2)	11.7 (10.3, 12.1)	4.2 (3.64, 4.76)

[a] P-values derived through Pearson's χ^2-test for independence between boys and girls.

Anthropometric characteristics and body fat assessment results by gender and BMI category are presented in Table 2. In all the presented characteristics, by the exception of age, there was a significant difference between normal weight, OW and OB children, in both genders (P for all < 0.05).

The KIDMED score was 3.65 ± 2.27 in the overall sample; only 4.3% of children had an optimal score (≥8), while 46.8% were classified as low adherers to the MD. KIDMED score did not differ between boys (3.64 ± 2.29) and girls (3.66 ± 2.24) (t-test = 0.18, P = 0.86); no differences were observed between normal weight (3.70 ± 2.26) and OW/OB children (3.62 ± 2.26) (t-test = 1.08, P = 0.28). In addition, no differences were found between the different age groups (F-test = 0.19, P = 0.83). However, children from urban and semi-urban areas of the country had higher KIDMED score (3.75 ± 2.28) as compared with those form large urban areas (3.56 ± 2.25) (t-test = −2.96, P = 0.003).

Further analysis (i.e., discriminant analysis) revealed that from the food groups considered for the KIDMED score, five were significant in classifying children into normal weight and overweight/obese categories. Specifically, cereals intake had the highest classification ability (Wilk's lamda = 0.976, P = 0.001), followed by sweets (lamda = 0.986, P = 0.011), various snacks (lamda = 0.988, P = 0.016), poultry (lamda = 0.988, P = 0.017) and starchy products (lamda = 0.991, P = 0.038).

Anthropometric, dietary and lifestyle characteristics of children according to their adherence to the MD are presented in Table 3. BMI, %BF and central adiposity indicators did not differ between the KIDMED score groups. Compared with low adherers, children with moderate KIDMED score had higher IPAQ score. Concerning the frequency of food groups consumption, children with higher KIDMED score were more likely to consume more frequently starchy foods and cereals, fruits, fruit juice, vegetables, dairy products (milk,

Table 2
Anthropometric characteristics and body fat assessment results by gender and BMI classification.

	Boys			Girls			Total sample		
	Normal	OW	OB	Normal	OW	OB	Normal	OW	OB
Age (years)	10.98 ± 0.76	10.92 ± 0.75	10.92 ± 0.78	10.88 ± 0.77	10.87 ± 0.70	10.77 ± 0.75	10.92 ± 0.75	10.90 ± 0.73	10.85 ± 0.77
BMI (kg/m^2)	17.7 ± 1.7[a]	22.5 ± 1.4[b]	27.7 ± 2.5	17.8 ± 1.8[a]	22.7 ± 1.5[b]	27.6 ± 2.5	17.8 ± 1.8[a]	22.6 ± 1.5[b]	27.6 ± 2.5
Waist (cm)	64.0 ± 6.1[a]	74.4 ± 6.4[b]	85.5 ± 7.9	62.5 ± 6.0[a]	72.9 ± 6.2[b]	83.0 ± 7.5	63.2 ± 6.1[a]	73.7 ± 6.3[b]	84.4 ± 7.8
Waist/hip ratio	0.83 ± 0.06	0.85 ± 0.06[b]	0.88 ± 0.06	0.80 ± 0.07[a]	0.82 ± 0.07[b]	0.84 ± 0.06	0.82 ± 0.07[a]	0.84 ± 0.07[b]	0.86 ± 0.06
Waist/height ratio	0.43 ± 0.04[a]	0.49 ± 0.04[b]	0.56 ± 0.05	0.42 ± 0.04[a]	0.48 ± 0.04[b]	0.54 ± 0.05	0.43 ± 0.04[a]	0.49 ± 0.04[b]	0.56 ± 0.05
Body fat mass (%)	13.5 ± 4.5[a]	23.0 ± 4.7[b]	32.3 ± 5.8	18.4 ± 6.5[a]	29.7 ± 4.7[b]	37.0 ± 4.7	16.1 ± 6.1[a]	26.4 ± 5.8[b]	34.5 ± 5.8

OW = overweight; OB = obese.
[a] P < 0.001 for comparisons between normal-weight and overweight (OW) and obese (OB) children for the total sample, as well as for boys and girls separately (Bonferroni corrected).
[b] P < 0.001 for comparisons between overweight and normal-weight and obese (OB) children for the total sample, as well as for boys and girls separately (Bonferroni corrected).

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Table 3
Anthropometric, lifestyle and dietary characteristics according to KIDMED score categories.[a]

	KIDMED (−4 to 12)			P[b]
	≤3	4–7	≥8	
N (%)	2240 (46.8)	2341 (48.9)	205 (4.3)	
Age (year)	10.94 ± 0.76	10.91 ± 0.74	10.90 ± 0.73	0.46
Male gender, %	48.4	49.3	51.7	0.59
Body mass index (kg/m^2)	20.4 ± 3.9	20.2 ± 3.7	20.4 ± 3.8	0.32
Waist circumference (cm)	68.9 ± 9.7	68.4 ± 9.6	68.4 ± 9.8	0.13
Waist/hip ratio	0.83 ± 0.08	0.83 ± 0.07	0.83 ± 0.08	0.55
Waist/height ratio	0.46 ± 0.06	0.46 ± 0.06	0.46 ± 0.06	0.10
% body fat	21.3 ± 9.0	20.9 ± 8.8	20.8 ± 8.5	0.26
IPAQ score (1–5)	2.87 ± 0.62	3.00 ± 0.58	3.05 ± 0.60	<0.001
Starchy foods and cereals				
Breakfast ready-to-eat cereals				<0.001
≥5 times/week vs. ≤4 times/week	29.5%	46.8%	74.6%	
Pasta and rice				<0.001
≥5 times/week vs. ≤4 times/week	51.0%	68.9%	85.9%	
Bread				0.02
≥7 times/week vs. ≤6 times/week	26.1%	29.5%	32.3%	
Legumes–Pulses				<0.001
≥2 times/week vs. ≤1 times/week	24.5%	54.4%	87.7%	
Fruits (at least one fresh fruit)				<0.001
≥7 times/week vs. ≤6 times/week	85.1%	96.8%	98.5%	
Vegetables (at least one portion of vegetables)[c]				<0.001
≥7 times/week vs. ≤6 times/week	31.2%	71.7%	98.0%	
Dairy products (at least 2 portions)[d]				<0.001
≥7 times/week vs. ≤6 times/week	48.1%	77.4%	92.2%	
Meat				
Red meat				<0.001
≥2 times/week vs. ≤1 times/week	28.8%	32.3%	44.6%	
Fish				<0.001
≥2 times/week vs. ≤1 times/week	19.9%	31.2%	53.2%	
Fast foods[e]				<0.001
≥2 times/week vs. ≤1 times/week	19.6%	17.4%	9.8%	
Nuts				<0.001
≥3 times/week vs. ≤2 times/week	6.4%	9.6%	18.6%	
Soft drinks (regular or diet)				<0.001
≥3 times/week vs. ≤2 times/week	17.7%	12.8%	9.9%	
Sweets and foods high in sugar (≥3 times/week vs. ≤2 times/week)[f]				
≥3 times/week vs. ≤2 times/week	22.8%	16.0%	9.6%	<0.001

[a] Values are means ± SD or percentages.
[b] *P*-values between all groups as derived from ANOVA or Chi-square test.
[c] Category including vegetables and fresh legumes consumption.
[d] Category including milk, cheese, and yogurt consumption.
[e] Category including burgers and souvlaki (traditional food with meat) consumption.
[f] Category including chocolate, chocolate bars and pastries.

cheese and yogurt), legumes, nuts, red meat, poultry, eggs, fish and seafood. High adherers to MD also reported less frequent consumption of ice cream, traditional Greek foods with meat (souvlaki and gyros), burgers, salty snacks, soft drinks, and sweets and foods high in sugar.

4. Discussion

In a nationwide, representative sample of Greek schoolchildren aged 10–12 years old, a very high prevalence of OW and OB, was observed. Based on the IOTF cut-offs, it was found that the prevalence of OW was 29.5% and the rate of OB was 11.7%. The rising prevalence of OW and OB in children has been associated with an increase in the prevalence of metabolic syndrome and type 2 diabetes [1,17]. Previous data on Greek children have revealed that OW and OB children had higher levels of plasma triglycerides (TG) and lower levels of HDL-C and physical fitness compared to their normal-weight peers [18]. In addition, it has been shown that the prevalence of insulin resistance is higher in OW and OB children compared with the normal-weight [17].

When comparing our results with other national data from Greece, it is evident that the percentages of overweight and obesity are higher. In the case of the study of Georgiadis and Nassis [19], the reported overall prevalence of OW and OB, from students 6–17 years old, were 17.3% and 3.6%, respectively. This discrepancy can be explained by the fact that the study presented national data of 1990–1991. Our results also differ considerably from those of Karayiannis et al. [20] reporting an overall prevalence of OW and OB in 11–16 years old children and adolescents of 15.3% and 1.8%, respectively, probably because of the fact that body weight and height data were self-reported and therefore could be less valid and reliable than direct measurements [21]. Finally, in a recent study examining 11-year trends (1997–2007) in overweight and obesity of 8–9 years old children, it was shown that the prevalence of overweight rose between 1997 and 2007 from 20.2% to 26.7% for girls and from 19.6% to 26.5% for boys. In addition, trend analysis showed an increase in the prevalence of obesity from 7.2% in 1997 to 11.2% in 2007 for girls and from 8.1% in 1997 to 12.2% in 2007 for boys [22].

Regarding underweight as a total of three grades of thinness, there is only one study in Greece referring to this problem and reporting that in 8–9 years old children the prevalence of underweight is stable over the decade (1997–2007) ranging from 7.5% to 9.6% and 9.6% to 12% for boys and girls, respectively, with girls having significantly higher rates than boys throughout the studied period [22]. Our results also demonstrate higher prevalence of

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underweight for girls than boys, a finding that agrees with data coming from other European countries where the overall reported prevalence of underweight ranged from 6.9 to 10.1% [23].

We also observed a gender difference in the prevalence of overweight and obesity since both OW and OB prevalence were higher in boys than in girls which is in agreement with recent data from European countries also showing that in most of them, the prevalence of overweight in boys is higher than girls [5,22,24]. However, we did not observe any differences in childhood OW and OB rates between large urban and semi-urban/rural regions of the country, which confirms similar findings from previous studies in Greece [19] and neither geographical disparities that have been observed in other Mediterranean countries [25].

In the present study only 4.3% of the children reported eating habits following the principles of the MD. Hence, our findings support previous evidence for low adherence to the dietary patterns of the MD, in children and adolescents in Mediterranean countries [26]. Although no differences were found in the BMI of the three different KIDMED score groups, results of our study provide evidence of the association between the level of adherence to the principles of the MD and the diet quality as well as a healthier lifestyle of children. In particular, it was shown that children with higher KIDMED score, also had more frequent consumption of fruits, vegetables, legumes, dairy products, fish, bread and nuts, and on the contrary had less frequent consumption of foods that according to the MD scheme should not be consumed regularly. However, due to the very low discriminating ability of the selected food groups (i.e., all foods had Wilk's lambda close to 1) it seems that these particular food groups consumption do not significantly contribute to children's classification into overweight/obese or non-obese groups. Moreover, children with higher KIDMED score reported having higher physical activity levels, indicative that besides following a healthier diet, also adopt a healthier lifestyle. The fact that high adherers to the MD also had more frequent consumption of red meat than the low adherers should be noted. This could probably be related to the fact that in order to ensure the adequacy of dietary iron intake in children, it is generally recommended to consume red meat more often than is suggested in the MD scheme. Therefore, it could be hypothesized that children's parents are encouraged to increase the weekly consumption of red meat.

The very low percentage of children with high adherence to the MD and the phenomenon of the nutrition transition could be related to the enhanced commercial availability of food, the overall improvement in socioeconomic conditions, and the high urbanization which has taken place in Greece over the last decades. The urbanization of life seems to be an important factor influencing the abandonment of the MD from the children, since we found that children from semi-urban areas had higher adherence to the MD compared with those form large urban areas.

The main strengths of our study are the nationally representative and large sample of school-children aged 10–12 years old and the relatively high response rate. Additionally, OW and OB rates were estimated with direct anthropometric measurements. An important limitation that has to be acknowledged is that the age range of the study, which was the late childhood and pre-adolescence, does not cover all age sections. Puberty, in particular, is a period of rapid growth in which boys and girls increase fat-free mass substantially, and in girls is associated with considerable increase in body weight and body fat-mass, therefore adolescence could be a critical period for developing obesity [27]. Future plans include to proceed into school-based childhood obesity prevention programs. It has been suggested that these kind of programs should target 10–14-year-old children, since it has been demonstrated that prevention trials including older children have positive outcomes in terms of reducing BMI [28]. Moreover, the cross-sectional design of the study does not allow for causal interpretations of the findings, and reverse causality may always exists in the relationship between diet and obesity.

In conclusion, the present study shows the alarming magnitude of the paediatric obesity problem in all areas and regions of Greece and the need for the establishment of long-term surveillance through population surveys in order to monitor secular trends in OB and to be able to reveal potential causative factors to combat the problem. Our findings support the notion and the general trend in Europe, showing that south European countries such as Spain, Italy, Portugal and Greece report the highest prevalence of obesity when compared to North European countries [5].

Recently the traditional MD was included on the UNESCO Representative List of the Intangible Cultural Heritage of Humanity as a "set of traditional practices, knowledge, skills, and consumption of food" (www.unesco.org/culture). Characterized by a nutritional model that "has remained constant over time passed on from generation to generation and providing a sense of belonging and continuity to the concerned communities". However, despite all the increasing evidence about the benefits of the Mediterranean diet, the present data witness the deviation from this diet towards a more Western-type diet with higher consumption of energy-dense foods and lower consumption of healthy foods that constitute the dietary pattern.

Taking into account recent studies suggesting that childhood obesity in most cases tracks into adulthood [2,3], the current findings are indicating an increased risk for even higher rates of obesity in adolescence and adulthood in the near future exceeding those currently reported for the Greek adult populations [29]. Since it is estimated that 30% of CHD and ischemic stroke and almost 60% of hypertensive disease in developed countries is attributed to excess BMI [30], the rising prevalence of childhood obesity in Greece is a serious public health issue, with an emerging need for preventing measures, and anti-obesity health policy interventions in order to improve the eating habits of the children that may continue into adulthood and reduce the risk for chronic diseases.

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PAPER II

Farajian P, Panagiotakos DB, Risvas G, Karasouli K, Bountziouka V, Voutzourakis N, Zampelas A. Socioeconomic and demographic determinants of childhood obesity prevalence in Greece: the GRECO (Greek Childhood Obesity) Study. *Publ Health Nutr* 2013; 16: 240-7.

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Socio-economic and demographic determinants of childhood obesity prevalence in Greece: the GRECO (Greek Childhood Obesity) study

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Abstract

Objective: Given the rapid increase in the prevalence of childhood obesity, identifying the sociodemographic influences on obesity status is important for planning and implementing effective prevention initiatives. However, this type of data is limited for Greek children. Therefore the aim of the present study was to identify possible sociodemographic factors associated with childhood obesity at the national level.
Design: Cross-sectional, population-based survey, carried out from October to May 2009.
Setting: Under the context of the GRECO (Greek Childhood Obesity) study, a nationwide sample of 2315 primary-school children.
Subjects: Children aged 10–12 years and their parents were voluntarily enrolled. Direct anthropometric measurements of the children were obtained and information on sociodemographic characteristics of the parents, as well as their self-reported values of body weight and height, were collected.
Results: Overweight and obesity prevalence was 29·5 % and 13·1 %, respectively, among boys; 29·5 % and 9·0 %, respectively, among girls. Multiple logistic regression analysis revealed that the most important sociodemographic predictors of childhood obesity were mother's age, parental BMI classification and father's type of occupation. More specifically, increased mother's age and normal BMI status of the parents seemed to have a protective effect on the likelihood of having an overweight/obese child. Additionally, the odds of a female child of being overweight/obese were reduced when the father's type of occupation tended to be less manual.
Conclusions: Anti-obesity health policy interventions have to address to the parents and promote their active involvement, to effectively confront the alarming magnitude of the paediatric obesity problem in Greece.

Keywords
Children
Obesity
Sociodemographics
Parents

Obesity among children and adolescents is a growing public health problem. Previous cross-sectional studies conducted at local and regional level have reported that the prevalence of childhood obesity in Greece is among the highest in Europe(1). According to Lobstein and Frelut(2), who provided estimates of the prevalence of overweight/obesity in European countries, Greece was ranked fourth highest in obesity rate for 7–11-year-olds. Recently published results from the GRECO (Greek Childhood Obesity) study(3), using nationally representative data from 10–12-year-old children and classification according to the International Obesity Taskforce cut-offs, verified the alarming magnitude of the paediatric obesity problem in all areas and regions of Greece, showing that the overall prevalence of overweight was 29·5 % and the prevalence of obesity was 11·7 %, the highest ever reported in Greece.

The rapid increase in the prevalence of obesity in Greece during recent decades suggests that behavioural factors play a primary role, these being influenced by genetic, social and economic environments. Although obesity and particularly childhood obesity has a multifactorial nature, it has been shown that obesity status differs by social class and demographic factors(4,5). However, a recent review by Shrewsbury and Wardle(5) highlighted the fact that the relationship between childhood overweight/obesity and socio-economic status (SES) depends on the SES indicator used and that, consequently, it is important to identify the correct sociodemographic influences on obesity status in contemporary societies in order to design and implement

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effective prevention initiatives. Early prevention is more effective in managing the epidemic of obesity, in comparison with treating obesity in later life.

For the Greek childhood population, such data are scarce and sometimes conflicting. This is probably because they have predominantly been derived from regional studies with populations of different cultural backgrounds, or because of the different SES indicators used. Therefore the aim of the present paper, under the context of the GRECO study, was to identify and present for the first time several possible socio-economic and demographic factors that are associated with the very high childhood obesity rate at the national level.

Methods

Sampling

The GRECO study was carried out from October to May 2009. A stratified sampling scheme by age and sex group, based on the population distribution (National Statistical Services, 2001 census) in ten regions of the whole country (i.e. Attica, Macedonia, Peloponnisos, Sterea Ellada and Evia, Ipeiros, Thessalia, Thrace, Aegean islands, Ionian islands and Crete), was used to obtain a representative sample of 5000 children. The number of children had been pre-specified using statistical power calculations in order to achieve 85 % power at 5 % type I error when evaluating odds ratios equal to 1·10. Thus, using also the official catalogues provided by the regional directorates of primary education, a total of 5850 fifth and sixth grade schoolchildren from fourteen prefectures were invited for potential inclusion. The prefectures were grouped based on their population into 'large urban areas' with a population size greater than 1 000 000 inhabitants and 'urban and semi-urban areas' with a population size ranging from 10 000 to 100 000 inhabitants.

The number of schools that agreed to participate in the GRECO study was 117 from all over the country (fourteen prefectures). From the overall number of children who were invited to participate in the study, signed parental consent forms were obtained for 4965 children (corresponding to 84·9 % participation rate). After checking the quality of the data obtained from the children and whether participants met the criteria for inclusion in the analysis, the resultant sample consisted of a total of 4786 children.

The research and all methods used in the study were approved by the Hellenic Ministry of Education (Department of Primary Education) as required by law for any study conducted in the school environment, during formal school hours, in Greece and the Agricultural University of Athens Research Committee. Before the initiation of measurements, an extended letter explaining the aims of the study was sent to the principal of each primary school. Additionally, each parent or guardian having a child in the contacted schools was provided with a letter explaining the aims of the study and a consent form. Those parents who agreed to participate in the study had to sign the consent form and send it back to the school.

Children's anthropometry and obesity definition

The measurements were conducted by investigators and staff of the Unit of Human Nutrition of the Agricultural University of Athens. All investigators followed a series of planning meetings and were trained in survey methods in training sessions that included practical experience in weighing and measuring techniques. Additionally, before the initiation of the study all investigators followed a two-week practice period in primary schools that were not included in the final study sample in order to get familiarized with the procedures. All study sites used the same measuring equipment and procedures and in each class the team of investigators consisted of at least two people.

All measurements were performed during morning hours. Body weight was recorded to the nearest 100 g with the use of a digital scale (Tanita TBF 300, Japan) and with the child standing without shoes in light clothing. Standing height was measured using a portable stadiometer (Leicester height measure, Germany) to the nearest 0·1 cm without shoes, with the head positioned in the Frankfort plane. BMI (kg/m^2) was calculated by dividing body weight in kilograms by the square of standing height in metres. Waist and hip circumferences were measured to the nearest 0·1 cm with the use of a non-elastic tape (Seca, Germany) and with the child in standing position. Waist circumference was measured at the end of a gentle expiration after placing the measuring tape in a horizontal plane around the trunk, midway between the lower rib margin and the iliac crest. Obesity and overweight among children were calculated using the International Obesity Taskforce age- and gender-specific BMI cut-off criteria[6].

Information obtained from parents/guardians

Information on socio-economic and demographic characteristics, such as parents' age, current weight and height, years of education, annual family income, employment status, profession, type of occupation (manual workers (lower values) to executive/skilled workers (higher values)) and ownership of the residence, was collected via a questionnaire, attached to the consent form. Parents were also asked about the frequency of physical activity alone or together with their children, as well as the frequency of meals consumed with the whole family and the frequency of meals 'out of home'. Of the 4786 consent forms obtained, in the case of 2318 children we also obtained answered parental questionnaires. Parental obesity and overweight percentages were estimated from self-reported values of body weight and height: BMI was calculated and BMI measures were used to define adult (parental) obesity (BMI $\geq$ 30·0 kg/m^2) and overweight

(BMI = 25·0–29·9 kg/m^2) according to the WHO classification[7]. The final number of parental questionnaires and families included in the analysis of the present paper was 2315.

Working sample

In the present paper, data from 2315 children (45 % males and 55 % females) for whom information about body weight and height was available, as well as the parents' questionnaire was completed, were used. The studied (working) sample can be considered representative of the overall study population (i.e. the 4786 children included for analysis in the GRECO study) with regard to age and BMI distributions ($P > 0·05$), as differences in age group and BMI distributions were not evident (working sample *v.* overall sample: 24 % *v.* 24 % aged 10 years, $P = 0·79$; 49 % *v.* 48 % aged 11 years, $P = 0·70$; 27 % *v.* 28 % aged 12 years, $P = 0·56$; 60 % *v.* 60 % normal weight, $P = 0·99$; 29 % *v.* 29 % overweight, $P = 0·99$; 11 % *v.* 11 % obese, $P = 0·99$). However, differences were revealed regarding gender ($P < 0·05$) and regional distribution ($P < 0·01$). Specifically, the working sample comprised 45 % boys (*v.* 49 % of the overall sample, $P = 0·027$) and 46 % were from urban areas (*v.* 52 % of the overall sample, $P = 0·002$).

Statistical analysis

Continuous variables are presented as means and standard deviations, and categorical variables as frequencies and percentages. The normality of continuous variables was tested graphically according to P-P and Q-Q plots. Comparisons of continuous variables between groups were performed using the independent-samples t test (for variables that were normally distributed). Associations between categorical variables were tested using the Pearson χ^2 test (bivariate level), while correlations between continuous variables were performed using Pearson's r. Unadjusted (univariate; i.e. child's gender, child's age, mother's and father's age, mother's and father's type of occupation, mother's and father's educational level, place of residence, annual family income and parental BMI classification) and multiple logistic regression analysis were used to evaluate the main effect of several sociodemographic characteristics on childhood obesity prevalence. Variables included in the model of multiple logistic regression analysis were selected according to the results of unadjusted models (i.e. $P < 0·05$) and as such to avoid collinearity. Specifically, child's age and gender, mother's age, father's type of occupation, father's educational level, place of residence, annual family income and parental BMI classification were included in the final model. Results are presented as odds ratios and the corresponding 95 % confidence intervals. The Hosmer–Lemeshow statistic was used to test the models' goodness-of-fit. All tested hypotheses were two-sided. $P < 0·05$ was considered as statistically significant. The PASW Statistics 18 statistical software package was used for all calculations (SPSS Inc., Chicago, IL, USA).

Results

The mean age of the 2315 children with anthropometric measurements and information regarding sociodemographic factors of their parents was 10·87 (SD 0·73) years, with 54 % and 46 % coming from large urban and urban plus semi-urban areas, respectively. In order to check for any bias regarding the data analysis of the sample of children used in the present study compared with the children for whom we did not obtain parental information, we compared the BMI of the two groups and found no differences ($P > 0·05$).

The descriptive characteristics of the population and the prevalence of overweight and obesity according to gender are presented in Table 1. In addition, comparisons of normal-weight and overweight/obese schoolchildren in relation to several sociodemographic factors and parental BMI classification are presented in Table 2. Concerning the obesity status of the parents, 25·5 %, 55·2 % and 19·3 % of the fathers and 65·3 %, 26·7 % and 8·0 % of the mothers were classified as normal weight, overweight and obese, respectively. BMI of the mothers and fathers was positively correlated with BMI and waist circumference of the children, in both genders ($P < 0·001$). Furthermore, no differences were observed in the prevalence of overweight, obesity or overweight/obesity combined in the overall sample and in both genders according to residence in large urban or urban plus semi-urban areas ($P > 0·05$ for all).

Table 1 Descriptive characteristics of the population and prevalence of overweight and obesity according to gender: nationwide sample of primary-school children aged 10–12 years, GRECO (Greek Childhood Obesity) study, October–May 2009

	Boys (*n* 1037)		Girls (*n* 1278)		Total (*n* 2315)	
	Mean	SD	Mean	SD	Mean	SD
Age (years)	10·91	0·75	10·84	0·73	10·87	0·73
BMI (kg/m^2)	20·47	3·97	20·18	3·74	20·31	3·85
Waist circumference (cm)	70·50	10·23	67·97	9·43	69·11	9·88
	n	%	*n*	%	*n*	%
Normal weight	595	57·4	786	61·5	1381	59·7
Overweight	306	29·5	377	29·5	683	29·5
Obese	136	13·1	115	9·0	251	10·8

Table 2 Comparison of normal-weight and overweight/obese schoolchildren in relation to socio-economic and demographic factors and obesity status of the parents: nationwide sample of primary-school children aged 10–12 years, GRECO (Greek Childhood Obesity) study, October–May 2009

		Normal-weight children		Overweight/obese children		
	n	Mean	SD	Mean	SD	*P* value
Mother's age (years)	2054	39·9	4·8	39·3	4·5	0·003
Father's age (years)	2018	44·3	5·4	44·0	5·6	0·288
Mother's years of education	1847	13·6	3·7	13·4	3·6	0·226
Father's years of education	1796	13·5	4·1	12·6	4·2	<0·001
Mother's type of occupation (1 = manual to 10 = non-manual)	1620	6·5	2·8	6·1	2·8	0·002
Father's type of occupation (1 = manual to 10 = non-manual)	1762	6·1	2·7	5·7	2·8	0·008
		%		%		
Mother's occupation						0·001
Unemployed	128	7·0		5·2		
Housewife	509	25·8		23·6		
Self-employed	315	14		17·4		
Private servant/employee	592	26·5		32·6		
Public servant/employee	474	25·0		20·5		
Retired	26	1·6		0·7		
Owns house						0·864
No	419	20·1		20·5		
Yes	1648	79·9		79·5		
Annual family income						0·031
Low	268	19·9		21·4		
Average	455	32·5		38·2		
High	585	47·6		40·3		
Number of cars per family						0·062
≤1	820	47·4		43·0		
≥2	976	52·6		57·0		
Place of residence						0·225
Large urban areas	984	47·1		44·4		
Urban and semi-urban areas	1154	52·9		55·6		
Mother's BMI classification						<0·001
Normal weight	1253	72·0		55·2		
Overweight/obese	667	28·0		44·8		
Father's BMI classification						<0·001
Normal weight	458	29·1		19·3		
Overweight/obese	1359	70·9		80·7		
Parental obesity status						<0·001
No parent overweight/obese	322	22·3		12·1		
One parent overweight/obese	938	55·7		49·1		
Both parents overweight/obese	508	22·0		38·8		

Regarding the physical activity levels of the parents, 40 % of the fathers and 42 % of the mothers were considered as physically active. Differences regarding the categorization of the parents according to their physical activity levels and the prevalence of overweight/obesity in their children were observed only for the fathers ($\chi^2 = 7{\cdot}14$, $P = 0{\cdot}008$). Specifically, for the overweight/obese children, 63 % of their fathers were categorized as not physically active, in comparison to 57 % of the fathers of normal-weight children. In addition, regarding the frequency of fathers' or mothers' physical activity together with their children, there were no differences regarding the prevalence of overweight/obese children ($\chi^2 = 0{\cdot}08$, $P = 0{\cdot}99$ and $\chi^2 = 4{\cdot}9$, $P = 0{\cdot}17$, respectively; data not shown in tables). Concerning the frequency of meals 'out of home' no differences were observed between normal-weight and overweight/obese children even after adjusting for children's gender ($P > 0{\cdot}05$ for all; data not shown in tables). In addition, no differences were observed in the distribution of frequency of meal consumption with the whole family with respect to overweight/obesity prevalence ($P > 0{\cdot}05$ for all; data not shown in tables).

Unadjusted logistic regression models were used to evaluate the effect of selected sociodemographic characteristics on the likelihood of child overweight/obesity. From the aforementioned factors, mother's age, mother's and father's type of occupation, mother's profession, father's educational level and parental obesity status were significant predictors of children's overweight/obesity status. More specifically, a 1 year increase in mother's age reduced the odds for child overweight/obesity by approximately 3 % (OR = 0·97, 95 % CI 0·95, 0·99). In addition, the odds of being an overweight/obese child were reduced when the mother's or father's type of occupation tended to be non-manual (OR = 0·94, 95 % CI 0·91, 0·98 and OR = 0·95, 95 % CI 0·92, 0·98, respectively). The same

Table 3 Results from logistic regression analysis to evaluate the main effect of various socio-economic and demographic characteristics of parents on the likelihood of childhood overweight/obesity, stratified by gender: nationwide sample of primary-school children aged 10–12 years, GRECO (Greek Childhood Obesity) study, October–May 2009

	Girls		Boys	
	OR	95 % CI	OR	95 % CI
Child's age (years)	1·00	0·77, 1·29	0·77	0·59, 1·00
Mother's age (years)	0·94	0·90, 0·99	0·95	0·91, 0·99
Father's type of occupation (1 = manual to 10 = non-manual)	0·91	0·83, 0·99	1·01	0·92, 1·10
Father's years of education	1·00	0·94, 1·05	0·98	0·92, 1·03
Place of residence				
Large urban areas	Reference category			
Urban and semi-urban areas	1·01	0·69, 1·47	1·64	1·12, 2·40
Family income				
Low	Reference category			
Average	2·14	1·21, 3·78	0·91	0·52, 1·60
High	1·60	0·87, 2·93	0·96	0·53, 1·72
Parental BMI classification				
No parent overweight/obese	Reference category			
One parent overweight/obese	1·92	1·09, 3·39	1·20	0·73, 1·98
Both parents overweight/obese	4·13	2·25, 7·56	2·66	1·50, 4·71

effect (i.e. decreased odds of being overweight/obese) was also noticed regarding father's high educational status (OR = 0·95, 95 % CI 0·93, 0·97). Moreover, two types of mother's profession (i.e. private servants/employees and self-employed) were significant predictors of children's overweight/obesity status. Finally, parental obesity status was shown to be a significant predictor of childhood overweight/obesity: when one parent was overweight/obese the odds of having an overweight/obese child were 1·62 (95 % CI 1·22, 2·14) times higher as compared with normal-weight parents. Furthermore, the odds of being an overweight/obese child were threefold higher when both parents were overweight/obese as compared with normal-weight parents (OR = 3·24, 95 % CI 2·39, 4·38). However, when these factors that were considered significant for developing overweight/obesity during childhood were evaluated together, adjusted for children's age and gender, only mother's age and parental obesity status (either one parent or both parents overweight/obese) were significant predictors for childhood overweight/obesity status (data not shown in tables). When the analysis was further performed stratified by children's gender, results revealed that mother's age was a protective predictor of both girls' and boys' obesity status, while parental obesity status had a positive effect on the likelihood of being an overweight/obese child. Additionally, father's type of occupation was found to be negatively related to the prevalence of overweight/obesity among girls, while the residence in urban plus semi-urban areas was also positively related to the prevalence of overweight/obesity among boys (Table 3).

Discussion

The present nationwide study is the first in Greece to examine associations between several socio-economic and demographic factors and obesity status among children. A recent review of cross-sectional studies published between 1990 and 2005 found that SES was inversely associated with children's overweight or obesity in 42 % of the reviewed studies, with the rest of the studies reporting a mixture of inverse or no associations[5]. The choice of SES variable obviously influenced these relationships, with the evidence being less conclusive when using family income as a possible variable explaining childhood obesity, while parental education showed the most consistent inverse relationship with children's obesity risk. In addition, studies examining secular trends in the effect of SES factors from childhood to adulthood have revealed a particularly important effect of SES during childhood on obesity status in adulthood[8].

According to the results of the present study, family income, the number of cars owned and house ownership did not seem to be related to the likelihood for children to be overweight or obese both at the bivariate level and in the multiple regression analysis performed. In contrast, the type of occupation of the parents, evaluated via a 10-point scale from unskilled (manual workers (lower values)) to executive (skilled workers (higher values)), which is considered indicative of social class[9] and family financial and educational status[10], did seem to affect the likelihood of having an overweight or obese child. However, we have to remark that the number of parental questionnaires with data concerning annual family income was smaller compared with the rest of the data provided, which may have introduced respondent bias from higher SES groups (Table 2).

In addition, paternal but not maternal education level seemed to be an important protective factor for childhood obesity, when analysed at the bivariate level. As reported in the literature, the most important sociodemographic factor explaining children's obesity status is parental education level, which is consistently inversely associated with children's body weight and adiposity[5,11]. Our results are reflective of such a relationship, suggesting that the level of education of the father is more likely to influence beliefs, knowledge on nutrition and health behaviours of the family, which in turn are involved in weight control through better nutritional and physical activity habits of the children[5,12–14].

Although maternal education level did not seem to influence the odds for overweight/obesity, an interesting finding of our study was that maternal profession appeared to influence the likelihood of the child being overweight/obese at the bivariate level. One possible explanation for the finding that children whose mothers were private servants/employees or self-employed had greater rates of overweight/obesity than children whose mothers were unemployed, housewives or public servants/employees is the possible difference in work hours. Although we did not specifically assess the hours of daily work of the parents, it could be hypothesized that self-employed and private employees in Greece have longer work schedules, keeping them outside the home. This is probably associated with the time dedicated to nutritional guidance and education of the child, as well as both the quality and quantity of the child's diet[15–17].

However, when the aforementioned factors that were considered significant for developing overweight/obesity during childhood at the bivariate level were evaluated together with other parameters, adjusted for children's age and gender, only mother's age and parental obesity status (either one parent or both parents overweight/obese) were significant predictors for childhood overweight/obesity status (data not shown in tables). When the analysis was further stratified by children's gender, results revealed that mother's age was a protective predictor for both girls' and boys' overweight/obesity status, while parents' obesity status had a positive effect on the likelihood of being an overweight/obese child (Table 3). Additionally, father's type of occupation was found to be related to the prevalence of overweight/obesity among girls, and particularly the odds of a female child being overweight/obese were reduced when the father's type of occupation tended to be less manual. The finding that the rural area of residence was positively related to the prevalence of overweight/obesity among boys was not shown in the analysis of the whole children's sample[3]; nor has it been verified in previous cross-sectional studies in Greece where no differences were shown in the prevalence of overweight/obesity between children from different geographical areas (urban, semi-urban, rural areas)[18,19].

The finding that the odds of developing overweight/obesity decreases with increasing maternal age could be partly explained by the notion that individual and as a consequence family health awareness is higher in mothers of advanced age. Although not many well-organized anti-obesity health policy interventions have taken place in Greece in recent years, there is extensive media attention to issues around obesity (diet and physical activity). Therefore it is possible that older mothers respond more actively to media health-related messages or seek guidance from health professionals. These results are consistent with the idea that mothers have the same if not greater influence than fathers on children's behaviours and often hold the role of the head of the household. Another possible explanation could be that older mothers to a lesser extent misclassify their children's weight status as being lower than actual, an ability which is an important determinant of a child's healthy body weight development[20]. However, in a recent publication examining maternal perceptions of pre-school children's weight status, mother's age did not seem to affect the ability to classify children's weight status correctly[20].

The present study also demonstrates that parental obesity status seems to be a highly influential factor on children's obesity status. Particularly when both parents were overweight/obese, the likelihood of male and female children to be overweight/obese was 2·66 and 4·13 times greater, respectively, than when children had no parent overweight/obese. An influence of parental obesity has been shown in many studies[21–23] and may be explained by genetic as well as environmental and behavioural factors since parents play a direct role in shaping children's eating and activity habits[24,25]. In a recent study performed in Greece (Crete) it was also shown that parental BMI status had the greatest effect on children's BMI classification, as children with two obese parents had 11·6 times higher likelihood of being overweight or obese than their peers with normal-weight parents[26]. These findings were confirmed in another study of Greek pre-school children, in which children with one obese parent had 91 % greater odds for being overweight than those with no obese parent, while the likelihood for being overweight was 2·38 times greater for children with two obese parents[27]. Children learn about eating not only through their own experiences but also by watching others, and especially their parents, who act as role models. A growing body of research demonstrates similarities between parents' and children's food acceptance, preferences and intake[15].

The main strength of our study is the nationwide and relatively large sample of schoolchildren aged 10–12 years. Additionally, overweight and obesity rates of the children were estimated with direct anthropometric measurements, allowing us to estimate overweight and obesity prevalences and assess the contribution of several SES factors in overweight and obesity variance. An important limitation that has to be acknowledged is that the age range of the study population, which was late childhood and pre-adolescence, does not cover all age sections and that we have not assessed the pubertal status of the children. Puberty, in particular, is a period of rapid growth in which boys and girls increase fat-free mass substantially, and in girls is associated with considerable increase in body weight and body fat mass; therefore adolescence could be a critical period for developing obesity[28]. It is in our future plans to proceed to conduct school-based childhood obesity prevention programmes. It has been suggested that these kinds of programmes should target 10–14-year-old children, since it has been demonstrated that prevention trials including older children have positive outcomes in terms of reducing BMI[29]. Another important limitation is the low response rate of the parental questionnaires, which may have introduced respondent bias from lower SES groups that are more likely to be either non-responders in survey research and overweight or obese[30]. However, in order to check for any bias regarding the data analysis of the sample of children used in the present study compared with the children for whom we did not obtain parental information, we compared the BMI of the two groups and found no differences. In addition, parental self-reported anthropometric values, although they may have some errors, are considered valid in identifying relationships in epidemiological studies, as when investigating associations with sociodemographic factors[31]. Finally, because the study had a cross-sectional design, it provides only evidence valuable for future investigations, but no definitive conclusions on causality.

Conclusions

The present study shows that the alarming magnitude of the paediatric obesity problem in all areas and regions of Greece[3] is associated with several socio-economic and demographic factors. The major sociodemographic determinants for childhood obesity in Greek children that retained statistical significance in the final multivariate model seem to be parental overweight, mother's age and father's type of profession.

Taking into account recent studies suggesting that childhood obesity in most cases tracks into adulthood[32,33], the current findings are indicating an increased likelihood or even higher rates of obesity in adolescence and adulthood in the near future, exceeding those currently reported for the Greek adult population[19,34]. The data from the present survey stress the emerging need for preventive measures and anti-obesity health policy interventions that have to address to the parents and promote their active involvement, to effectively confront the paediatric obesity epidemic.

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PAPER III

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Perinatal and family factors associated with preadolescence overweight/obesity in Greece: The GRECO study

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Abstract *Objective:* To explore associations of perinatal and family factors with preadolescence overweight and obesity in a sample of Greek schoolchildren.

Methods: A nationwide cross-sectional study among 2093 students (10.9 ± 0.72 years, 44.9% boys) and their parents were conducted. Anthropometric (e.g., height, weight, mother's body mass index (BMI) at the time of the study and at conception), socio-demographic (e.g., age, education, socio-economic status), diet and other major lifestyle characteristics (e.g., smoking, alcohol intake, physical activity and inactivity) and perinatal factors (e.g., breast- and formula-feeding) were collected with validated questionnaires. Height and weight of students were measured. Overweight/obesity was classified using IOTF cut-offs. Multivariable logistic and linear regression analyses were used to identify major independent factors of overweight/obesity among preadolescents and factors related with the percentage change of mother's BMI, respectively.

Results: Increased age at pregnancy [odds ratios (OR) = 0.95, 95% Confidence Interval (CI): 0.93–0.97], higher BMI at conception (OR = 1.17, 95% CI: 1.12–1.22) and heavy smoking (OR = 2.02, 95% CI: 1.23–3.33) were positively associated with child's overweight/obesity status. Moreover, mother's age and TV viewing, indicating inactivity, were the strongest factors of the percentage increase in mother's BMI ($b \pm se = 0.23 \pm 0.07$, $p = 0.002$; $b \pm se = 0.32 \pm 0.10$, $p = 0.002$, respectively).

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Conclusions: Preadolescent obesity is associated with mother's pre-pregnancy weight, age and heavy smoking at conception and mother's BMI change after gestation.

1. Introduction

Childhood and adolescent obesity is now an epidemic, as an alarming increase has been noted in the prevalence of overweight and obesity throughout Europe and especially in the Mediterranean countries [1]. This is also depicted in several Greek studies [2,3] as adulthood obesity can be tracked back to early life [4]. Therefore, it is important to study the main causes of obesity in youth. Fetus growth in the uterus and the first years of life have been proposed to affect an offspring's later development, body composition and health status [5–6], although there have been some confounders to this hypothesis. In the uterus, the fetus experiences a period of rapid growth, multiplication of the cells and differentiation of the organs, while during infancy the function and development of the brain, metabolism and other physiological mechanisms are regulated. Thus it is important to investigate perinatal factors and their predictive role in obesity progression. Pre-pregnancy weight [7,8], weight increase during gestation [7,9], gestational age [10,11], smoking habits before and during pregnancy [12–17], alcohol [10,11] and coffee [18] consumption during the same period, birth weight [9,19,20] and breastfeeding duration and lifestyle of the mother during lactation [21,22] have been found to be strongly related to an elevated risk of overweight and obesity, either directly or through mediating factors, such as fetal growth restriction [18] and rapid weight gain [22]. In addition, the Fleurbaix–Laventie Ville Santé Study in France [23] showed that mother's body mass index (BMI) is a significant factor of her children's BMI after puberty, giving more ground for research in the field of prospective effect of mother's weight on the likelihood of having an overweight/obese offspring.

Relative studies in Greece have evaluated the link between factors associated with overweight or obesity in childhood [24] and adolescence [25]. However, information regarding the association of perinatal and family environment on the prevalence of overweight/obesity is limited. Thus, this work, as a part of the GRECO (Greek childhood obesity) study, aimed to investigate the perinatal and family factors that are related to the prevalence of children's overweight/obesity and the factors associated with mother's weight gain. As a benefit, the results of this work may assist the development of health promotion programs focused on preventing obesity.

2. Methods

In order to provide national estimates of overweight and obesity among Greek schoolchildren, as well as to evaluate possible risk factors, a nationally representative survey, the GRECO study, was performed among fifth and sixth grade students of primary schools aged 10–12 years old.

2.1. Study's sampling procedure

The study was carried out from October 2008 to May 2009. A total of 4786 children (10.9 ± 0.75 years, 49.3% boys) were voluntarily enrolled in the study (participation rate 95%). The number of schools that agreed to participate in the study was 117 from 10 regions all over the country. All participating children were informed about the aims and the procedures of the study, and their parents signed parental consent forms. A more detailed description of the sampling procedure has been reported elsewhere [3].

2.2. Measurements: Anthropometry, obesity and underweight definition

All measurements were conducted by trained personnel (i.e., nutritionists and dietitians) of the Unit of Human Nutrition of the Agricultural University of Athens. All measurements were performed during morning hours. Body weight was recorded to the nearest 10 g with the use of a digital scale (Tanita TBF 300) and with subjects standing without shoes in light clothing. Standing height was measured using a portable stadiometer (Leicester height measure) to the nearest 0.1 cm without shoes, with the head positioned according to the Frankfort plane. BMI was calculated by dividing weight (kg) by standing height squared (m^2). Obesity and overweight measures among children were calculated using the IOTF (International Obesity Task Force) age- and gender-specific BMI cut-off criteria [26].

2.3. Dietary and physical activity assessment

Dietary assessment was based on a validated, self-reported, semi-quantitative food frequency questionnaire (FFQ), including 48 food items commonly used in the local Greek cuisine [3,27]. The KIDMED index (Mediterranean Diet Quality Index for children and adolescents) was used to evaluate the degree of children's adherence to the Mediterranean diet [28]. Physical activity status was measured using the Physical Activity Questionnaire for Older Children (PAQ-C) [3,29].

2.4. Information obtained by parents/ guardians

Information on parents' demographic characteristics, such as parents' age, years of education, annual household income, employment status (i.e., non-working vs. private sector, public sector, freelance), profession, type of occupation (i.e., manual, mixed, non-manual), and ownership of the residence, were collected via a questionnaire that was given to the children's parents/guardians.

Of the 4786 questionnaires obtained by the children, 2138 were also answered by their parents (45% participation rate). Parents' body height (m) and weight (kg) were self-reported and used to calculate parents' BMI (kg/m^2) and to define parents' overweight (BMI 25–29.9 kg/m^2) and obesity (BMI $\geqslant$30 kg/m^2), according to the World Health Organization classification for adults. Parents' lifestyle characteristics, such as physical inactivity (measured by hours of TV viewing/week), physical activity status (yes vs. no) and quality of diet, according to MedDietScore were also collected. MedDietScore (range 0–55) is used to evaluate parents' adherence to the Mediterranean Diet, with high values indicating high adherence to this particular regime [30].

Participants' mothers were additionally asked to complete a questionnaire regarding their demographic and lifestyle characteristics during pregnancy. Specifically, they were asked about their age (years) at pregnancy, body weight (kg) at conception, weight gain during pregnancy (kg), total period of gestation (weeks), smoking habits at conception, gestation and lactation (none, 1–9 cigarettes/day, 10–20 cigarettes/day, $\geqslant$20 cigarettes/day, in all cases), coffee intake at gestation (none, 1 cup/day, $\geqslant$2 cups/day), alcohol intake at gestation and lactation (none, 1 drink/day, $\geqslant$2 drinks/day) and for the number of exclusive and total (i.e., along with formula milk intake) months of breast feeding. The percentage (%) change of mother's BMI was also calculated as the difference between the current BMI (at the time of the study) and the BMI at conception according to the following formula: $(BMI_{(current)} - BMI_{(conception)}) \times 100/BMI_{(current)}$.

2.5. Working sample

In this paper, data from 2093 children (10.9 ± 0.72 years, 44.9% boys) were used, in which information about weight and height was available, as well as a completed parents' questionnaire. The studied sample could be considered as representative of the overall study population (i.e., the 4786 children included for analysis in the GRECO study) as regards children's age and BMI distributions (both p's > 0.05), but not gender ($p < 0.05$), and region ($p < 0.01$).

2.6. Statistical analysis

Results are presented as mean (SD) for the normally distributed variables, as median (25th percentile, 75th percentile) for the skewed ones and as frequencies for the categorical. The normality of the distributions regarding continuous variables was tested using graphical methods (i.e., p–p plots and histograms). Differences in the distribution of various characteristics between normal weight and overweight/obese participants were assessed using the t-test (for the normally distributed variables, i.e., weight of neonates at birth, mother's age at pregnancy, mother's BMI at conception, mother's current BMI, % increase in mother's body mass index) and the Mann–Whitney test (for the skewed, i.e., mother's weight gain during pregnancy, total weeks of gestation, months of exclusive breastfeeding, and months of total breastfeeding). Associations between categorical variables were tested using Pearson's chi-square test (i.e., smoking habits at conception, gestation and lactation; coffee intake at gestation; alcohol intake at gestation and lactation). Unadjusted logistic regression analyses were used to evaluate the association of pre- and post-natal factors on the likelihood of overweight/obesity in preadolescents. To account for residual confounding, multivariable logistic regression models for each one pre- and post-natal factor were also estimated after adjustment for children's age, sex, physical activity level (according to the IPAQ score) and quality of diet (according to the KIDMED index) (*Multivariable 1*). Moreover, all factors that were found to be significantly associated with overweight/obesity among preadolescents in previous analyses were included in multivariable logistic regression analysis, after checking for co-linearity (children's age, gender, physical activity and quality of diet adjusted) (*Multivariable 2*). The Wald test was used to hierarchy the factors that contribute the most to the model. Hosmer-Lemeshow statistic was used to test models' goodness-of-fit. Results are presented as odds ratios (OR) with their corresponding 95% Confidence Intervals (95% CI). Furthermore, a multivariable linear regression model was also performed to evaluate the factors that may be associated with the % change of mothers' BMI. Results are presented as $b \pm$ se along with their corresponding 95% CI. Weighting factors, according to children's age (i.e., 10—14) and gender distribution (i.e., boys/girls) by prefecture (i.e., Attica region, Central Greece, Peloponnese, Ionian islands, Epirus, Thessaly, Macedonia, Thrace, Aegean island, Crete) were applied to all analyses performed. All tested hypotheses were two-sided; p-value < 0.05 was considered statistically significant. SPSS version 18.0 software was used for all calculations (SPSS, Inc., Chicago, IL, USA).

3. Results

The prevalence of overweight/obesity among preadolescents according to IOTF cut-offs for the working sample ($n = 2093$) was 42% and did not differ from the prevalence reported for the total sample (i.e., 41%, $n = 4786$, $p = 0.44$) [3]. The distribution of pre- and post-natal anthropometric and lifestyle characteristics between normal weight and overweight/obese participants is presented in Table 1.

In order to accurately evaluate the association of pre- and post-natal factors with the likelihood of being an overweight/obese preadolescent, further analysis was applied and results are presented in. Unadjusted logistic regression analysis for the assessment of pre- and post-natal factors was performed, according to the observed differences in the distribution of the tested characteristics in both children's BMI groups. Results based on the unadjusted logistic models suggest that mother's age before pregnancy was inversely associated with the likelihood of being an overweight/obese preadolescent (OR = 0.96, 95% CI: 0.94—0.98). On the contrary, mother's BMI at conception, and thus % change of mother's BMI, and heavy smoking at conception and gestation were positively associated with the likelihood of being an overweight/obese preadolescent. Specifically, 1 kg/m^2 increase of mother's BMI at conception was associated with 13% increase in the likelihood of being an overweight/obese child during preadolescence (95% CI: 1.08—1.18), while smoking >20 cigarettes/day before pregnancy and >10 cigarettes/day at gestation was associated with 2.45 and 2.84 higher odds of being an overweight/obese preadolescent, respectively (95% CI: 1.68—3.58 and 1.47—5.48, respectively). Results do not seem to alter when models were adjusted for children's age, gender, physical activity status (as measured by the IPAQ score) and quality of diet (as measured by the KIDMED index). Furthermore, children's age, gender, physical activity status (as measured by the IPAQ score), quality of diet (as measured by the KIDMED index), mother's age and BMI at conception, % change of mother's BMI and smoking habits at conception and at gestation were included in a multivariable logistic model. Results confirmed the previous findings. Moreover, 1% increase in mothers' BMI was associated with 2% increase in the likelihood of being an overweight/obese child during preadolescence (95% CI: 1.01—1.03) (Table 2).

According to the previous model, the % increase in mother's BMI was one of the most important factors associated with preadolescence overweight/obesity (Wald test = 1641, $p < 0.0001$), followed by mother's BMI at conception and mother's age at pregnancy. Therefore, characteristics that may be associated with this change (i.e., mother's age, educational status, type of occupation, employment status, physical inactivity and activity and dietary habits) have been considered as factors associated with mother's % increase in BMI. Results revealed that one year increase in mother's age was associated with 0.23 kg/m^2 change in mother's BMI (se = 0.07, 95% CI: 0.08, 0.37), adjusted for all previously mentioned factors. In addition, sedentary lifestyle (as measured in hours of TV viewing per week) was associated with a % increase in mother's BMI ($b \pm$ se = 0.32 ± 0.10, 95% CI: 0.12—0.51) (Table 3).

4. Discussion

This study examined pre- and post-natal factors that influence the prevalence of overweight and obesity in preadolescents in Greece. The perinatal factors which were found to have a strong association with overweight/obesity were high maternal weight at conception and maternal heavy smoking (>20 cigarettes per day) at conception, even after adjustment for confounding factors. High maternal age at gestation was inversely associated with overweight and obesity. Moreover, as far as mother's weight change from conception to the time of the study is concerned, results revealed

Table 1 Differences between pre- and post-natal factors distribution (i.e., anthropometric and lifestyle characteristics) regarding to children's obesity status.[†]

	n	Normal-weighted (*n* = 1216)	Overweight/obese (*n* = 877)	$p^{\ddagger}$
Weight of neonates at birth (g)	1412	3261 (541)	3328 (519)	0.01
Mother's age at pregnancy (years)	1726	28.5 (4.9)	27.6 (4.6)	<0.001
Mother's body mass index at conception (kg/m^2)	1927	21.4 (2.8)	22.5 (3.2)	<0.0001
Mother's current body mass index (kg/m^2)	2074	23.6 (3.6)	25.0 (4.3)	<0.0001
% Increase in mother's body mass index*	1870	8.4 (9.7)	9.1 (10)	<0.0001
Mother's weight gain during pregnancy (kg)	1768	13.0 (10.0, 18.0)	14.0 (10.0, 19.0)	<0.0001
Smoking habits at conception (%)				<0.0001
No	1205	63	56	
1–9 cigarettes/day	321	15	17	
10–20 cigarettes/day	361	18	18	
>20 cigarettes/day	129	4.2	9.1	
Smoking habits at gestation (%)				<0.0001
No	1791	90	85	
1–9 cigarettes/day	210	9.3	12	
⩾10 cigarettes/day	40	1.1	3.1	
Smoking habits at lactation (%)				<0.0001
No	1795	92	90	
1–9 cigarettes/day	159	7.4	9.0	
⩾10 cigarettes/day	10	0.5	0.8	
Coffee intake at gestation (%)				<0.0001
No	831	42	39	
1 cup/day	1027	51	51	
⩾2 cups/day	158	7.2	10	
Alcohol intake at gestation (%)				<0.0001
No	1986	96	97	
⩾1 drink/day	86	4.4	3.3	
Alcohol intake at lactation (%)				0.004
No	1870	96	96	
⩾1 drink/day	82	4.3	4.1	
Total weeks of gestation	1365	38.0 (36.0, 40.0)	38.0 (36.0, 40.0)	0.58
Months of exclusive breastfeeding	1514	2.0 (0.5, 4.0)	2.0 (1.0, 5.0)	0.10
Months of total breastfeeding	1815	3.0 (1.0, 6.0)	3.0 (1.0, 6.0)	0.93

* % Increase in mother's body mass index has been calculated as the difference between mother's current body mass index (at the time of the study) and body mass index at conception.
† Normally distributed continuous variables are presented as mean (standard deviation), while skewed as median (25th percentile, 75th percentile) and categorical as frequencies.
‡ *p*-Values were derived through comparisons between normal-weighted and overweight/obese children using *t*-test for normally distributed variables, Mann–Whitney test for skewed and Pearson's chi-square for categorical.

that an increase in mother's body weight may result in a considerable increase in the odds of having an overweight/obese offspring. Despite the limitations derived from the cross-sectional design, the results presented here have a considerable public health impact since they send out a clear message to the mothers that their lifestyle is associated with their offspring's health.

The weight of the mother at conception affects fetal growth and is an indicator for later obesity. High pre-pregnancy weight may even double the odds for the 2-year-old offspring to be obese, as observed in the past [7]. Markedly, the odds ratio for the pre-pregnancy weight revealed a stronger association with preschoolers' obesity than with newborns and this effect seems to be strong in adolescence, too. More specifically, Kuhle *et al.* showed that for maternal pre-pregnancy weight over 80 kg, compared with a body weight less than 60 kg, the OR was 4.42 [8].

Table 2 Results from logistic regression analysis for the assessment of the main effect of pre- and post-natal factors on the likelihood of being an overweight/obese pre-adolescent.

	Unadjusted		*Multivariable 1*†		*Multivariable 2*‡	
	OR	95% CI	OR	95% CI	OR	95% CI
Weight of neonates at birth (kg)	1.00	1.00–1.00	1.00	1.00–1.00	–	–
Mother's age at pregnancy (years)	0.96	0.94–0.98	0.96	0.94–0.98	0.94	0.92–0.97
Mother's body mass index at conception (kg/m^2)	1.13	1.08–1.18	1.13	1.09–1.18	1.17	1.12–1.22
Mother's % increase of body mass index* (kg/m^2)	1.01	1.00–1.02	1.01	1.00–1.02	1.02	1.01–1.03
Smoking habits at conception§						
0 cigarettes/day	1.00	–	1.00	–	1.00	–
1–9 cigarettes/day	1.28	0.99–1.65	1.26	0.98–1.63	1.32	0.99–1.77
10–20 cigarettes/day	1.10	0.86–1.41	1.09	0.85–1.40	0.97	0.70–1.36
>20 cigarettes/day	2.45	1.68–3.58	2.43	1.66–3.56	2.02	1.23–3.33
Smoking habits at gestation§						
0 cigarettes/day	1.00	–	1.00	–	1.00	–
1–9 cigarettes/day	1.34	1.00–1.80	1.32	0.99–1.78	1.31	0.87–1.97
⩾10 cigarettes/day	2.84	1.47–5.48	2.84	1.46–5.54	2.24	0.88–5.67

* % Increase in mother's body mass index has been calculated as the difference between mother's current body mass index (at the time of the study) and body mass index at conception.
† *Multivariable 1* regression models adjusted for children's age, gender, physical activity status (according to IPAQ score) and quality of diet (according to KIDMED score).
‡ *Multivariable 2* regression model adjusted for children's age, gender, physical activity status (according to IPAQ score), quality of diet (according to KIDMED score) and all other factors (i.e., mother's age at pregnancy, mother's body mass index before conception, mother's % body mass index change, smoking habits at conception and gestation).
§ *p*-Trend = 0.001 for the univariate adjusted models in both cases.

Table 3 Results from linear regression analysis to evaluate the association of mother's socio-demographic and lifestyle characteristics on the % increase of mother's body mass index* (kg/m^2).

	b ± se	(95% CI)
Mother's age (years)	0.23 ± 0.07	(0.08, 0.37)
Mother's educational status (years)	−0.13 ± 0.11	(−0.34, 0.07)
Mother's type of occupation		
Manual	Reference	
Mixed	−1.49 ± 1.02	(−3.48, 0.51)
Non-manual	−2.48 ± 1.16	(−4.75, −0.20)
Mother's job status		
Non-working†	Reference	
Free lancer	−0.84 ± 1.03	(−2.86, 1.17)
Private sector	−0.82 ± 0.97	(−2.73, 1.09)
Public sector	1.35 ± 1.02	(−0.66, 3.35)
TV viewing (hours/week)	0.32 ± 0.10	(0.12, 0.51)
Intense physical activity (yes vs. no)	−1.05 ± 0.57	(−2.16, 0.06)
MedDietScore (0–55)	0.06 ± 0.03	(−0.01, 0.13)

* % Increase in mother's body mass index has been calculated as the difference between mother's current body mass index (at the time of the study) and body mass index at conception.
† Category includes unemployed, housekeeping and retired.

In addition, previous research in the field of parents' weight change throughout their offspring's life is scarce. In only one French study, maternal adiposity and its effect on the adiposity of the child was assessed [23]. Several phenomena could account for this pattern of correlations. First, a cumulative effect of a shared familial environment could strengthen the parent–child correlation over time. Secondly, with puberty, additional genetic factors may be involved in hormone secretions related to subcutaneous adiposity development and then participate in these stronger parent—child correlations in post- rather than the pre-pubertal period. Obviously, this merits more research in order to confirm or refute this hypothesis.

Research on maternal smoking during pregnancy and subsequent growth appears to have consistent outcomes. According to CESAR, a study performed in Central and Eastern Europe, the mean OR for six countries in the region was 1.26 [12], while the pooled OR in a large literature review of 14 studies that took place in Europe, Australia and North America was 1.52 [13]. In Greece, Moschonis *et al*. [24] reported an OR of 1.72 for preschoolers developing obesity when the mother was both a passive and an active smoker during pregnancy. Intrauterine exposure to tobacco smoke is proposed to have adverse effects on birth weight. In other words, children of smokers tend to be lighter at birth, but at the same time have a greater chance for developing obesity, while the OR increases with age, suggesting strengthening of the relationship over time [14]. Other reported data are also consistent with the present findings, suggesting a dose-depended association between pre-natal smoking and obesity [8,15]. In contrast, a study performed by Gilman *et al*. [16] failed to demonstrate a strong association between these two characteristics. Using a siblings' model and after adjustment for confounders, it was shown that family level factors influence the studied relation. Those findings are opposite to those of von Kries *et al*. [15], who proposed a strong influence by the intrauterine environment and not by the lifestyle of the parents. When analyzing smoking during the different trimesters of pregnancy and its impact on the risk of overweight/obesity, the outcomes were inconsistent [17].

The strong relation between a newborn's weight at birth and later obesity may be a proof for the crucial role of intrauterine growth in the development of obesity. A recent study performed by Kuhle *et al*. [8] in schoolchildren aged 10 and 11 years old was in line with the findings reported herein. Previously reported data have also supported that heavy newborns tend to become heavy children, with odds ratios (OR) varying from 1.50 to 2.30 [19]. In a large study in 10,683 children who were followed up until the age of 33, Parsons *et al*. [20] indicated that in younger age groups the association between birth weight and BMI was linear; however, as age increased, the association became more J shaped. It is noticeable that when controlling parental BMI, the association became stronger.

The results of previous Greek studies are similar. Panagiotakos *et al*. [25] support that birth weight over 3500 g increased the odds for overweight and obesity in girls (OR = 1.85) and Moschonis *et al*. [24] presented a protective effect of low birth weight against overweight in preschoolers (OR = 0.56). The latter lower the likelihood for later obesity, or the absence of any influence concerning obesity as it was noticed in the results of this study which was also encountered elsewhere in the literature [8].

Previously, no other Greek study has examined the factor of mother's weight at conception, as researchers usually focus their attention on excessive weight gain during pregnancy, which was positively associated with an elevated risk for overweight/obesity [7,9]. Findings of this study do not support these results, probably owing to the small percentage of mothers who were overweight/obese, according to self-reported data. However, a 5% increase in the likelihood of being an overweight/obese offspring during preadolescence was noticed for every kg increase in maternal body weight at conception. This increase is mainly attributed to physical inactivity of the mother after the birth of her offspring.

As far as smoking habits are concerned, data showed a strong relation between heavy smoking at conception and overweight/obesity at preadolescence. This could probably be explained by the lifestyle patterns of the parents, which could lead to the increased BMI of an offspring. According to findings of this study, another strong factor of preadolescent overweight/obesity was mother's age at gestation. The likelihood of being an overweight/obese offspring was higher for younger mothers, although previous studies did not support this [7,24], probably owing to the limited mother's age span of the sample and predominantly around 40 years of age.

5. Limitations

This study does not evaluate all the perinatal factors, like diabetes during pregnancy, mother's nutritional habits, parity, complications during pregnancy, post-natal hospitalization and socioeconomic status, while a number of perinatal data were self-reported 10—12 years later in time resulting in probable recall bias. In addition, collected data regarding smoking and alcohol intake during pregnancy were not checked regarding their validity and reliability. Finally, cross-sectional studies include a number of limitations, as their main purpose is to evaluate prevalence and not to prove causality between different factors. Thus, the results presented here are lacking a causal basis, but may be helpful for stating future research hypotheses.

6. Conclusion

Childhood and adolescent obesity is claimed to have its origins in intrauterine and early life. This study was an effort to present a strong association between preadolescents' overweight/obesity and mother's pre-pregnancy weight, mother's weight change from conception until the time of the study, mother's age and smoking habits at conception and birth weight. Monitoring the effect that pre- and post-natal factors have on the levels of overweight and obesity in Greece is a task of high priority in order to plan an effective prevention strategy.

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PAPER IV

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TITLE PAGE

Title: Hierarchical analysis of dietary, lifestyle and family environment risk factors for childhood obesity: the GRECO study

Running head: Hierarchical analysis of obesity risk factors

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Abstract

Background/Objectives: To facilitate the development of practical public health advice targeted at childhood obesity (OB) prevention and make the intervention programs more effective, one has to promote the most protective habits and limit or modify the risk factors. The objective of the present study was to recognize the most important dietary and physical activity habits, sedentary behaviors, plus parental influences that are associated with childhood overweight (OW) and OB, in a nationwide, cross-sectional sample of Greek schoolchildren.

Subjects/Methods: Data from 4552 children (9-12 years old) and 2225 of their parents were included in the analysis. Direct anthropometric measurements and information on dietary and physical activity habits were obtained from the children, plus parental self-reported anthropometric values, perceptions, and family environment information.

Results: Multiple logistic regression analysis revealed that the most important predictors of childhood OW/OB were breakfast frequency (OR 0.95; 95% CI 0.92-0.97), daily number of meals and snacks (OR 0.92; 95% CI 0.87-0.97), the frequency of family meals (OR 0.86; 95% CI 0.76-0.99), having both TV and PC/Videogame player in the bedroom (OR 1.41; 95% CI 1.18-1.69), and studying hours in weekdays (OR 1.07; 95% CI 1.02-1.13). In the case of parents, mothers' age (OR 0.91; 95% CI 0.86-0.97), maternal (OR 1.13; 95% CI 1.06-1.21) and paternal (OR 1.08; 95% CI 1.02-1.15) BMI, and children's BMI misclassification (OR 6.22; 95% CI 3.62-10.71) were significant predictors of children’s OW/OB.

Conclusions: These findings could guide future investigations or public health initiatives to prevent and confront the childhood obesity epidemic more efficiently.

Keywords: Obesity, children, sedentary behaviors, dietary habits, parental perceptions, misclassification

Introduction

The prevalence of overweight and obesity among children and adolescents has increased markedly during the past years. Besides the identified rising prevalence of childhood obesity during the last decades in the US[1], there are many epidemiological studies showing that childhood obesity is an escalating health problem in many European countries as well[2]. Particularly in countries surrounding the Mediterranean sea overweight (OW) and obesity (OB) prevalence rates are reported to be the highest among other European countries[3,4]. Childhood overweight tracks into adulthood[5], thus increasing the risk for chronic diseases that occur commonly among overweight/obese adults. In addition, paediatric OW/OB has consistently been found to be associated with cardiovascular disease risk factors such as insulin resistance, dyslipidemia, and increased blood pressure[6].

Many behaviours that affect the energy balance and/or the satiety feeling in children have been identified as factors that protect or promote the prevalence of childhood OW/OB. Specifically, behaviours like skipping breakfast, infrequent meals during the day, consuming energy-dense but nutrients poor foods like fast-foods, french-fries, salty snacks, and sweets have frequently been associated with increased body mass index (BMI) and adiposity[7-9]. Furthermore, low physical activity levels and sedentary behaviours (increased screen viewing time) have been related to OW and OB[10], as well as short sleep duration[11,12]. Additionally, it is well documented that family members exert an integral role in the development and maintenance of their child's health and dietary behavior. Parental misperceptions regarding their children's body weight status, diet quality and physical activity patterns, have been related with an increased risk of childhood obesity, and recognized as barriers for early OW/OB prevention and intervention[13,14].

Based on all the aforementioned factors, the etiology of childhood and adolescence obesity's nature has been characterized as complex and multifactorial. Many different studies have identified several risk factors related with childhood OW/OB, which someone has to take into account when planning or implementing preventive actions. However, in order to facilitate the formation of practical and effective public health advice targeted at childhood obesity prevention, and make the prevention programs more effective, one has to target to promote the most protective habits and limit or modify the risk factors.

Therefore, the aim of the present study was to identify those dietary and physical activity habits and behaviors, as well as parental perceptions and influences that are associated with childhood OW/OB, and to recognize the most important parameters, in a representative, cross-sectional sample of Greek schoolchildren.

Materials and methods

Sampling procedure

Information regarding subjects' collection has been reported in detail elsewhere[4,15]. In brief, under the context of the GRECO study, during 2009 a representative number of randomly selected public primary schools (fifth and sixth grade primary schoolchildren) were invited to participate to the study, according to a stratified sampling procedure by 10 regions of the country. After data quality control a total sample of 4552 children was finally included in the analyses of the present study. Signed parental consent forms were obtained for all children included in the analysis. This study was conducted according to the guidelines laid down in the Declaration of Helsinki. The research tools and all the means used in the study were approved by the Hellenic Ministry of Education (Department of Primary Education), and the Agricultural University of Athens Research committee.

Anthropometric characteristics

Body weight (kg) was recorded to the nearest 100 g with the use of a digital scale (Tanita TBF 300). Standing height was measured using a portable stadiometer (Leicester height measure) to the nearest 0.1 cm without shoes. Body mass index (BMI) was calculated by dividing weight (kg) by standing height squared (m^2). Obesity and overweight among children were calculated using the International Obesity Task Force (IOTF) age and gender specific body mass index cut-off criteria[16]. All measurements were performed during morning hours.

Dietary and eating behavior assessment

Dietary assessment was based on a validated self-reported, semi-quantitative picture-aid food frequency questionnaire (FFQ), consisted of 48 food items commonly used in the local Greek cuisine[17]. All participants were asked about their usual frequency of consumption of the food items (average over the last year) with the following response categories: Everyday, 3–6 times/week, 2 times/week, 1 time/week, 1–2 times/month and seldom/never. The questionnaire included supplementary questions assessing the frequency of breakfast consumption and eating occasions (number of meals and snacks during the day), as well as the frequency of having meals in front of a screen (watching television/DVD/videos and/or using of games consoles/computer), and the frequency of having meals together with the whole family or at least with one family member with the following response categories: Everyday, 5–6 times/week, 3-4 times/week, 1-2 times/week, and seldom/never.

Other characteristics

All participants were asked to complete the Physical Activity Questionnaire for Older Children (PAQ-C) (score 1-5)[18]. Children with scores above the 75th percentile (PAQ-C score

3.34) were classified as high active, while the rest as low to moderate active. Children were also asked whether they had television (TV) or computer (PC) in their room, they take a midday nap (siesta) and how many hours they sleep at weekdays and weekends. Furthermore, the average weekdays and weekend time (h/d) spent on sedentary activities and more specifically on watching television/DVD/movies and/or recreational usage of games consoles/computer was defined as screen time. By combining the former two responses, mean daily hours of watching television/DVD/movies and/or recreational usage of games consoles/computer was calculated. Responses were coded into two categories (<2 hours and ≥2 hours per day) of low- and high-sedentary. Children were then grouped into 4 behavioral categories on the basis of their sedentary behavior and physical activity scores: 1) high active-low sedentary, 2) high active-high sedentary, 3) low active-low sedentary, and 4) low active-high sedentary. Finally, children were asked to report the average weekdays and weekend time spent on studying and doing their homework.

Parental characteristics and perspectives

Information on socioeconomic and demographic characteristics such as parents' age, years of education, type of occupation [manual workers (lower values)] to executive/skilled workers (higher values)], and annual income, were collected via a questionnaire, attached to the consent form. Parents were also asked about the frequency of eating meals "out of home", and were asked to report the persons (up to two persons) who were mainly responsible for the child's feeding in terms of organising meals, amounts of foods offered, and deciding what the child is going to eat (i.e., mother, father, grandmother, grandfather, home personnel). Of the 4965 consent forms obtained, in the case of 2318 children we also obtained answered parental questionnaires (48% participation rate). After data quality control a total of 2225 parental questionnaires were included in the present analysis. Parental obesity and overweight percentages were also estimated from self-reported values of body weight and height. BMI measures were used to define parents' obesity (BMI ≥ 30 kg/m^2) and overweight (BMI: 25.0-29.9 kg/m^2*),* according to the World Health Organization classification[19].

Parents were also asked to report their perspective on the body weight status of their child (i.e., lower than normal, normal, higher than normal), to evaluate their child quality of diet using a 10-grade scale (1: low quality/unhealthy, 10: high quality/healthy), and to report their perspective on the physical activity levels of their children (i.e., very low, low, normal/satisfactory, intense, very intense). Information regarding parents' dietary habits and practices was also collected. In particular, they were asked to complete the MedDietScore (range 0-55) in order to evaluate their adherence to the Mediterranean Diet[20].

Statistical analysis

Results are presented as mean (SD) for normally distributed continuous variables and relative frequencies for the categorical variables. Normality was tested using graphical methods (i.e., histograms and P-P plots) and homogeneity of variance was tested with the Levene's test. The Student's *t*-test and one-way ANOVA were applied to evaluate differences in mean values of normally distributed data. To adjust for a significance level of 5%, the Bonferroni rule was applied in each of the multiple comparisons. Spearman correlation coefficients were calculated for the association between parental perception of their children's diet and the daily servings of foods. Associations between categorical variables were tested by contingency tables and chi-square test. Unadjusted and multiple logistic regression analysis were used to evaluate the main effect of several parental and children's characteristics on childhood overweight/obesity prevalence. Variables included into the model of multiple logistic regression analysis were selected according to the results of unadjusted models (i.e., $p<0.05$) and as such to avoid collinearity. Results are presented as odds ratios (OR) and the corresponding 95% confidence intervals. Hosmer-Lemeshow statistic was used to test the models' goodness-of-fit. All reported p-values were based on a two-sided test hypothesis and compared with a significance level of 5%. The SPSS v18.0 software was used for all analyses (SPSS Inc, Chicago, IL, USA).

Results

Among participating children, according to the IOTF cut-offs, 29.5% were classified as overweight and 11.7% as obese. The prevalence of overweight and obesity was higher in boys than girls ($X^2=7.37$, $P=0.02$) and the same result was shown after combining overweight and obese (OW/OB) subjects into one category ($X^2=4.40$, $P=0.04$). Children's anthropometric, lifestyle, as well as dietary patterns according to their classification into normal weight (NW) and OW/OB are presented in Table 1. Having TV and/or computer/video game player in the children's room was associated with higher screen time both in weekdays and weekends ($P<0.001$). Concerning the 4 behavioral categories on the basis of children's sedentary behavior and physical activity scores, no differences were found between boys and girls in their classifications. However, boys who were classified as high active-low sedentary when compared with low active-high sedentary, had significantly lower BMI values ($P=0.028$). In girls, no differences were found between the 4 behavioral categories concerning their mean BMI values or the prevalence of OW/OB (data not shown in Tables).

Table 1. Socio-demographic and lifestyle characteristics of children participants, according to their BMI status

	Normal-weight	Overweight/ Obese	P
N	2676	1876	
BMI, (Kg/m^2)	17.74 (1.76)	23.85 (2.86)	<0.001
Male gender, (%)	47.5	50.7	0.04
Age, yrs	10.93 (0.73)	10.87 (0.72)	0.004
Having TV in the bedroom, (%)	36.7	44.4	0.001
Having PC/Videogame player in the bedroom, (%)	40.0	43.4	0.023
Having TV and PC in the bedroom, (%)	17.7	22.6	<0.001
TV watching and Videogame playing in weekdays, (hours)	1.96 (1.35)	2.02 (1.41)	0.128
TV watching and Video game playing in weekends (hours)	2.88 (2.02)	3.04 (2.18)	<0.017
Physical activity, PAQ-C score (5-scale)	2.95 (0.60)	2.95 (0.61)	0.794
Sleeping duration in weekdays (min)	534 (58)	525 (57)	0.001
Sleeping duration in weekends (min)	610 (98)	601 (108)	0.001
Studying hours (Weekdays)	2.56 (1.24)	2.68 (1.31)	0.002
Studying hours (Weekends)	2.69 (1.66)	2.74 (1.69)	0.28
Sleep in the afternoon, (%)	14.5	15.4	0.38
Sleeping hours in the afternoon	1.18 (1.12)	1.21 (1.14)	0.674

Having breakfast (times/week)	4.62 (2.42)	4.24 (2.46)	<0.001
Number of meals and snacks during the day	3.19 (1.25)	3.02 (1.24)	<0.001
Having meal while watching TV or playing video games (times), (%)			0.065
Rare	48.3	50.2	
1-2 times/week	30.9	28.7	
3-4 times/week	10	8.3	
5-6 times/week	3.9	4.3	
Daily	6.9	8.5	
Having meal with father or mother, (%)			0.002
Rare	5.4	6.5	
1-2 times/week	18.6	22.0	
3-4 times/week	18.1	18.5	
5-6 times/week	16.2	12.6	
Daily	41.7	40.4	
Frequency of meals outside home	1.39 (0.88)	1.38 (0.86)	0.626

Continuous variables are presented as mean (SD) and categorical variables are presented as percentages.

Regarding parental anthropometric, socio-demographic and lifestyle characteristics as well as their perceptions and beliefs, according to their children's BMI status, these are presented in Table 2. According to the parents' perspective on the body weight status of their child, only 25.4% of the parents reported believing that their child had increased BMI, while the actual measured percentage of children categorized as OW/OB was 41.9%. Interestingly, in the case of

OW/OB children, 47.9% of their parents reported believing that their children was normal weight (47.1%) or even under-weight (0.8%). In contrast, in the case of NW children 16.5% of their parents reported believing that their children was underweight (11.3%) or OW/OB (5.2%) (P<0.001) (Table 2). The comparison between parents who did or did not misclassify their child's body weight, showed no difference in the BMI values, but a difference in mothers' (but not fathers') age was evident, since mothers who correctly judged their children's BMI status were older in age (P=0.04). In addition, in the case of children whose grandparents were mainly responsible for the child's feeding the prevalence of OW/OB was significantly higher.

Table 2. Socio-demographic and lifestyle characteristics of the parents (*n* 2225), according to BMI status of their children

	Normal-weight	Overweight/ Obese	P
Mothers' age, (years)	40.0 (4.78)	39 (4.52)	0.002
Fathers' age, (years)	44.4 (5.38)	44.1 (5.6)	0.19
BMI of mothers, (Kg/m^2)	23.7 (3.7)	25.2 (4.3)	<0.001
BMI of fathers, (Kg/m^2)	26.9 (3.25)	28.2 (3.7)	<0.001
Dietary habits, MedDietScore (0-55)	28.4 (5.5)	27.4 (5.7)	<0.001
Income of father, (%)			0.22
<10,500 €	14.2	14.8	
10,500-12,000 €	19.4	21.4	
12,000-30,000 €	54.6	51.5	
30,000-70,000 €	10.6	9.8	

>70,000 €	1.3	2.5	
Income of mother, (%)			0.36
<10,500 €	32.4	35.3	
10,500-12,000 €	18.9	20.5	
12,000-30,000 €	44.0	39.9	
30,000-70,000 €	3.8	2.9	
>70,000 €	0.9	1.4	
Fathers' education (years of school)	13.5 (4.1)	12.8 (4.2)	<0.001
Mothers' education (years of school)	13.6 (3.7)	13.5 (3.6)	0.46
Fathers' type of occupation (1=Manual – 10=Non manual)	6.04 (2.74)	5.75 (2.75)	0.027
Mothers' type of occupation (1=Manual – 10=Non manual)	6.50 (2.77)	6.08 (2.78)	0.003
Children's quality of diet, (0-10)	7.79 (1.76)	7.08 (2.08)	<0.001
Feeding of the child-Grandparents, (%)	10.2	12.9	<0.01
Children's physical activity levels, (%)			<0.001
Very low	*4.2*	*10.0*	
Low	*15.8*	*28.1*	
Normal/Satisfactory	*58.5*	*47.8*	
High	*15.8*	*10.6*	
Very high	*5.6*	*3.6*	
Parental perception of children body weight status			<0.001

% of misclassification	16.5	47.9

Continuous variables are presented as mean (SD) and categorical variables are presented as percentages.

Children were also categorized into physical activity levels groups, according to the perspective of their parents (i.e., very low, low, normal/satisfactory, intense, very intense). Groups were compared in relation to the children's PAQ-C scores as well as children's grouping in behavioral categories on the basis of children's sedentary behavior. In both cases, irrespectively of gender and age, no differences were found between the different categories of children. Furthermore, parental perceived ranking of their children's diet quality was positively associated with greater daily consumption of legumes, natural fruit juices, fresh fruits, several types of vegetables (including fresh vegetables and fresh legumes), milk and dairy products, eggs, poultry, fish, and honey/jam consumption, but negatively correlated with pizza, burgers, salty snacks, and soft drinks daily consumption (data not shown in Tables).

When the factors that were considered significant for developing OW/OB during childhood were evaluated together, only age, frequency of having breakfast during the week, the number of meals and snacks during the day, the frequency of family meals, having both TV and PC/Video game player in the room, and studying hours in weekdays remained significant predictors for childhood OW/OB status (Table 3). In the case of parental parameters, multiple regression analysis showed that mothers' age, paternal and maternal BMI, and misclassification of the children BMI status remained significant predictors of childhood OW/OB prevalence, among several other parameters (Table 4).

Table 3. Results from logistic regression analysis to evaluate the main effect of various characteristics of children on the likelihood of childhood overweight/obesity.

	OR	95% CI
Gender		
Girls	Reference category	
Boys	1.10	0.96, 1.26
Age (yrs)	0.91	0.83, 0.99
Family meals frequency		
Less than 5 times/week		Reference category
5 or more times/week	0.86	0.76, 0.99
Having TV and/or PC/Videogame player in the bedroom		
No		Reference category
Having TV or PC	1.11	0.96, 1.28
Having both TV and PC	1.41	1.18, 1.69
Breakfast (times per week)	0.95	0.92, 0.97
Meals and snacks frequency (per day)	0.92	0.87, 0.97
Hours of TV/PC in weekends	1.02	0.99, 1.06
Studying hours in weekdays	1.07	1.02, 1.13

Table 4. Results from logistic regression analysis to evaluate the main effect of various characteristics and perceptions of parents on the likelihood of childhood overweight/obesity.

	OR	95% CI
Mothers' age	0.91	0.86, 0.97
Paternal BMI	1.08	1.02, 1.15
Maternal BMI	1.13	1.06, 1.21
Fathers' education (years of school)	0.97	0.90, 1.06
Mothers' education (years of school)	1.02	0.93, 1.11
Children's' body weight status misclassification	6.22	3.62, 10.71
Feeding of the child by grandparents	1.42	0.79, 2.60
Dietary habits, MedDietScore (0-55)	0.97	0.93, 1.02
Children's quality of diet, (0-10) as perceived by the parents	0.90	0.79, 1.03
Children's physical activity levels, as perceived by the parents		
Very low	Reference category	
Low	0.96	0.34, 2.56
Normal/Satisfactory	0.63	0.24, 1.63
High	0.38	0.12, 1.18
Very high	0.29	0.07, 1.29
Fathers' type of occupation (1=Manual – 10=Non manual)	0.96	0.85, 1.08
Mothers' type of occupation (1=Manual – 10=Non manual)	1.10	0.97, 1.25

Discussion

In a nationwide, representative sample of Greek schoolchildren aged 10-12 years old with the highest prevalence of OW and OB ever reported in Greece[4], childhood OW/OB was associated with several dietary and physical activity habits, parental characteristics and perceptions. In order to better present our data, and hierarchy the factors, results are presented separately for children and parents, since as it has been established any type of successful anti-obesity interventions in children and adolescents should also involve parents[14,21].

In agreement with previous studies, our findings which persisted after adjustment for confounders show that the habit of having breakfast and the higher number of meals and snacks during the day are inversely associated with the prevalence of OW/OB in children[7,8,22,23]. Specifically, for each increment in breakfast consumption (per week) and eating occasion (per day), the likelihood of children to be OW/OB was reduced by 5% and 8% , respectively (Table 3). Given the consistent association of skipping meals with an increased obesity risk in children, it has been suggested that it is prudent to promote a regular meal pattern with 5 meals per day with adequate composition to children and their families[24]. Another eating habit that proved to protect against obesity risk, were the frequent family meals, since children who reported having meals with at least one of the family members 5 or more times per week had 14% reduced risk for OW/OB than the children with more infrequent family meals. A similar reduction of the odds of being overweight was reported in the meta-analysis of Hammons and Fiese[25], in which children and adolescents who had family meals 3 or more times per week, also had an increase in the odds for eating healthy. Although the specific mechanisms of how family mealtimes influence nutritional habits and protect against childhood overweight are not entirely revealed, it has been postulated that family meals promote social interaction and allow parents to act as dietary role models and control both the quality and quantity of their child's diet[13,25,26].

Concerning the effects of physical activity levels as assessed by the physical activity questionnaire for children (PAQ-C)[18] on the likelihood of OW/OB, we found no association. Although many studies have found a negative association between physical activity and BMI or weight gain in children, obviously explained by the increased energy expenditure[22,27,28], there are also reports showing weak or no association[8,29]. This inconsistency could be partially attributed to the assessment tools used in the studies. The specific questionnaire we used (PAQ-C) has the advantage of being validated and widely used in the literature, however, it does not discriminate between specific activity intensities, such as moderate and vigorous activities. In the study of Wong & Leatherdale[10], the authors highlight the fact that the relationship between physical activity and BMI may be moderated by sedentary activity. Thus when researchers try to investigate the relationship between physical activity and BMI, they should also consider to assess the type and level of physical inactivity. Indeed, in the case of the present study, when children were grouped into 4 behavioral categories on the basis of their sedentary behavior and physical activity scores, boys who were classified as high active-low sedentary when compared with low active-high sedentary, had significantly lower BMI values. Furthermore, children who had both TV and PC/Video game player in their bedroom had 41% increased risk for OW/OB, while screen time viewing during weekends also showed a trend towards increasing the likelihood of OW/OB. According to recent reports, having TV in the children bedroom is positively associated with measures of adiposity, mediated by TV viewing time[30]. Interestingly, studying (reading-doing homework) hours in weekdays, which is another sedentary behavior reported in the literature[10], increased the odds for children being OW/OB approximately 7% for every extra hour. This newly revealed observation cannot be evaluated against previous studies since as far as we know there are no similar data in the literature. An important feature of Greek public primary schools is that the statute of extended schools, in which studying hours are included, has begun during the last decade and is not applied in all schools. Therefore, for a proportion of children the lack of studying time within the school curriculum, obligates them to do their homework during the afternoon hours, and thus reducing spare time which could be devoted to physical activities.

Regarding parental characteristics, as also identified in our previous study investigating the socio-demographic influences on obesity[15], children whose mothers were older in age had a reduced risk of being OW/OB. A possible explanation for this observation could be the notion that individual and as a consequence family health awareness is higher in mothers with increasing age, and shown in the present analysis the ability to judge their children's body weight correctly and as a consequence to misclassify to a lesser extent their children's weight status as being lower than actual, and take actions to confront the problem. In addition, both maternal and paternal BMI were significant predictors for childhood OW/OB status, an effect previously shown in Greek childhood population[31]. Since obesity etiology involves a complexity of genetic, behavioral and socio-economic and cultural factors, parents play a central part in all of them[32]. Their role in shaping children's eating and activity habits is direct since they are primarily responsible for food procurement, and meal preparation and can be a strong positive influence towards more healthy food choices and lifestyle.

Besides mothers' age and parental BMI status, the most dominant risk factor according to the results of the present study was the parental misperception of the children's body weight status and the inability to recognise overweight in their children. The likelihood of parents who misclassified their child's body weight status, to have an OW/OB child was 6.22 times greater. A similar study performed in Greek preschool children aiming to evaluate the maternal misclassification rate of child weight status, demonstrated that almost 38% of mothers underestimated their child's weight status[14]. There is a growing body of evidence showing that a significant proportion of parents fail to recognise overweight status of their child, probably because of a lack of awareness of what overweight means or unwillingness to admit the problem[33,34]. Irrespective of the cause, if parents cannot recognize the problem of overweight they do not also realize the health consequences, and do not take actions to treat the situation, and improve the children's diet quality. As also shown in the present study, parents besides misperceiving their children's body weight status, also failed to recognize whether or not the physical activity levels of their child were sufficient or inadequate and if the engagement in sedentary activities was higher than recommended. Nevertheless, parental perceived diet quality of their children was closer to reality, since higher ranking was related with greater consumption of foods that are recommended to be consumed on a regular basis[35].

The main strength of our study is the nationwide and large sample of school-children aged 10-12 years old, and the relatively large number of factors assessed. An important limitation that has to be acknowledged is the low response rate of the parental questionnaires that may have introduced respondent bias. However, in order to check for any bias regarding the data analysis of the sample of children used in the present study compared to the children for which we did not obtain parental information, we compared the BMI of the two groups and found no differences. In addition, parental self reported anthropometric values although may have some errors, are considered valid in identifying relationships in epidemiological studies[36]. Finally, because the study had cross-sectional design, it provides only evidence valuable for future investigations, but no definitive conclusions on causality.

In summary, in an attempt to recognize and rank the most important parameters associated with childhood OW/OB, it was found that breakfast consumption, frequent eating occasions, and regular family meals were negatively associated with OW/OB and could therefore have a protective role in this age group. Although the physical activity levels did not correlate with BMI levels, sedentary behaviors were included in the lifestyle parameters that mostly affect the likelihood of overweight, as well as the presence of TV and PC/video game player in the children's bedroom. An important public health issue raised according to the results of the present study, is the inability of parents to recognize OW/OB, a problem that markedly increases the risk of overweight. These findings could facilitate and guide future investigations or public health initiatives to focus on these parameters among others, in order to prevent and confront the childhood obesity epidemic.

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Conflict of Interest:

The authors declare that they have no conflicts of interest.

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PAPER V

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TITLE PAGE

TITLE: Anthropometric, lifestyle and parental characteristics associated with the prevalence of energy intake misreporting in children: the GRECO study

Running title: Energy intake misreporting in children

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Abstract

The objective of this work was to identify misreporting children and evaluate characteristics that are related with its prevalence, in a nationwide, cross-sectional sample of Greek schoolchildren. Under the context of the GRECO study, data from a total of 4547 children aged 10–12 years and 2318 parents were included in the analysis. Anthropometric, lifestyle and parental characteristics plus concerns and beliefs were investigated in relation to the prevalence of misreporting. Thirty-six percent of the children were classified as under-reporters and 16% as over- reporters. Multinomial logistic regression analysis revealed that the most important predictors of energy under-reporting were BMI [Odds Ratio (OR) 1.06; 95% Confidence Intervals (CI) 1.02, 1.11) and weight satisfaction (OR 0.88; 95% CI 0.79, 0.98). In the case of over-reporting, BMI (OR 0.84; 95% CI 0.78, 0.91), meals and snacks frequency (OR 1.53; 95% CI 1.33, 1.76), female gender (OR 0.64; 95% CI 0.45, 0.90), parental perception that the body weight of the child was normal (OR 0.52; 95% CI 0.30, 0.91), and maternal education (OR 0.95; 95% CI 0.90, 0.99) remained as significant predictors. In conclusion, the present study confirms that the issue of under- and over-reporting in childhood populations is evident and quite serious. Although there are no definite guidelines on how to use data obtained from misreporters in an epidemiological dataset, validity seems to be influenced by children's BMI status, the need to report socially acceptable habits, as well as parental perceptions regarding their children's weight.

Keywords: Under-reporting; over-reporting; children; parental perceptions

Introduction

Accuracy of dietary assessment is essential in nutritional research, where diet and health or disease associations are investigated. Habitual intakes of foods and consequently nutrients are often assessed through self-reported methods depending on the needs of studies [1]. Though, it is generally recognized that obtaining accurate dietary data is difficult due to misreporting of dietary intake, diet-disease associations are established on the assumption that self-reported dietary intake is accurate and reflect usual intake [2]. However, research, mostly in adults, has shown that dietary misreporting is often observed selectively in energy dense, nutrient-poor foods perceived as unhealthy, as well as in sub-categories of the population influenced by psychological concerns such as body image and weight dissatisfaction, need of social approval and desirability, and restrained eating [3,4]. Thus, when systematic rather than random errors occur, they produce significant reporting bias that may attenuate or exaggerate the associations between dietary factors and health outcomes [5,6].

According to recent validation studies misreporting of energy intake is quite evident in children and adolescents as well, with rates of under-reporting increasing with age and weight status [4]. The prevalence of under-reporting, depending on the assessment tools used, has been reported to vary from 2-85%, while the prevalence of over-reporting varying from 3-46% [7]. Although a series of characteristics (i.e., socio-demographic, eating behaviors, body image, lifestyle, physical activity) and its' relation with under-reporting has been previously studied, these reporting biases from habitual eating patterns are not fully studied, especially among children, while data regarding over-reporting are even more limited [8].

Thus, the objectives of this study were to identify children misreporters (under- and over-reporters), evaluate anthropometric, lifestyle and parental characteristics that are related with the prevalence of misreporting, and to assess psychological parameters that are associated with under- and over-reporting, in a representative sample of Greek schoolchildren (the GRECO study).

Experimental methods

Study sample

The study was carried out from October to May 2009, under the context of the GRECO study [(9)]. A stratified sampling scheme by age and sex group, based on the population distribution (National Statistical services, 2001 census), in 10 regions of the whole country was used to obtain a representative sample of 5000 children, using the official catalogues provided by the regional directorates of primary education. The number of children had been pre-specified using statistical power calculations in order to achieve a 85% power at 5% type I error when evaluating odds ratios equal to 1.10. The number of schools that agreed to participate in the study was 117 from all over the country (10 regions and 14 prefectures). From the overall number of children that were invited to participate in the study, signed parental consent forms were obtained for 4965 children. After checking the completeness of the provided data, the working sample of the present study included 4547 voluntarily enrolled fifth and sixth grade schoolchildren with a mean age of 10.9 (0.75) years (49.3% males). This study was conducted according to the guidelines laid down in the Declaration of Helsinki. The research tools and all the means used in the study were approved by the Hellenic Ministry of Education (Department of Primary Education) as the law provides in Greece for any studies conducted in the school environment during formal school hours, and the Agricultural University of Athens research committee. Signed parental consent forms were obtained from all children participating in the study.

Anthropometric characteristics

Body weight (kg) was measured to the nearest 100 g with the use of a digital scale (Tanita TBF 300). Standing height was measured using a portable stadiometer (Leicester height measure) to the nearest 0.1 cm without shoes. Body mass index (BMI) was calculated by dividing weight (kg) by standing height squared (m^2). Obesity and overweight among children were calculated using the IOTF (International Obesity Task Force) age and gender specific body mass index cut-off criteria [(10)]. Waist and hip circumferences were measured to the nearest 0.1 cm with the use of a non-elastic tape (Seca, Germany). Waist to hip (W/Hp) ratio was also calculated. Percentage of body fat (%BF) and body fat mass were estimated by the foot to foot impendence method (Tanita TBF 300). All measurements were performed during morning hours.

Dietary and eating behavior assessment

Dietary assessment was based on a validated self-reported, semi-quantitative picture-aid food frequency questionnaire (FFQ), consisted of 48 food items commonly used in the local Greek cuisine [(11, 12)]. All participants were asked about their usual frequency of consumption of the food items. Pictures regarding the standard size of each food item's portion included in the questionnaire to assist children report the exact food quantity consumed. The questionnaire included supplementary questions assessing the frequency of breakfast consumption and eating occasions (number of meals and snacks during the day), as well as the type of the foods consumed [i.e., consumption of: a) whole wheat products (cereals, pasta, bread, cereal bars, rusks), b) brown rice, c) low fat milk and yogurt, d) low fat mayonnaise, e) light soft drinks]. To estimate the daily energy, the United States Department of Agriculture food composition tables [13] and local food composition tables [14] were used.

Other characteristics

All participants were asked to complete the Physical Activity Questionnaire for Older Children (PAQ-C) [15]. Children were also asked to report to time spent on watching TV and recreational usage of games consoles/computer during weekdays and weekends (hours/day). By combining the former two responses, mean daily hours of watching television/DVD/movies and/or recreational usage of games consoles/computer (defined as screen time) was calculated. Responses were coded into two categories (<2 hours and ≥2 hours per day) of low- and high-sedentary. Additionally, children were asked to report how content they felt by their body weight using a 5-point scale [1(Not at all) – 5 (Very content)] and to consider and report their weight. The former question was applied before the actual body weight measurement. Based on this information the deviation between the actual measured weight value and the perceived weight was calculated.

Estimation of misreporting

Energy misreporting (i.e., under- and over- reporting) was estimated using the Goldberg equation [16] according to the ratio of energy intake (EI) to basal metabolic rate (BMR). In particular, age-specific Schofield's equations were used to estimate BMR from measured weight [17], while physical activity level (PAL) was set on 1.55 indicating moderate activity according to mean values of PAQ score. The evaluation of individual intake considering long records was based on 28 days as the FFQ used in the present study referred to usual food intake of the past. The within subject daily variation in EI (CV_{wE}) was set at 23% as suitable average value [18], the variation in BMR (CV_{wB}) was set at 8.5% and the between subject variation in physical activity (CV_{tP}) was set at 15% as suitable averages [16]. According to these, under-reporters of EI were defined as those with EI:BMR<1.09, while over-reporters of EI were those with EI:BMR>2.21.

Parental characteristics

Information on socioeconomic and demographic characteristics such as parents' age, years of education, type of occupation [manual workers (lower values)] to executive/skilled workers (higher values)], were collected via a questionnaire, attached to the consent form. Parents were also asked about the frequency of physical activity alone or together with their children (i.e., 1 time/week, 2-3 times/week, 4-5 times/week, ≥6 times/week), as well as the frequency of consumed meals with the whole family, and the frequency of meals "out of home". Of the total consent forms obtained, in the case of 2318 children we also obtained answered parental questionnaires (51% participation rate). Parental obesity and overweight percentages were also estimated from self-reported values of body weight and height. BMI measures were used to define adult (parental) obesity (BMI $\geq$ 30 kg/m^2) and overweight (BMI: 25.0-29.9 kg/m^2), according to the World Health Organization classification [19].

Parents were also asked to report their perspective about the body weight of their child (i.e., lower than normal, normal, higher than normal) and to evaluate their child quality of diet using a 10-grade scale (1: low quality/unhealthy, 10: high quality/healthy). Parental dietary habits and practices were assessed with the completion of the MedDietScore (range 0-55) in order to evaluate their adherence to the Mediterranean Diet (higher values indicate high adherence to the scheme) [20].

Statistical analysis

Results are presented as mean (SD) for normally distributed continuous variables, median (25th percentile, 75th percentile) for the skewed ones and frequencies (%) for the categorical variables. Normality was tested using graphical methods (i.e., histograms and P-P plots) and homogeneity of variance was tested with the Levene's test. Differences in the distribution of continuous variables between the three categories of energy reporters (i.e., under-, plausible, and over-reporters) were assessed using oneway ANOVA F-test for the normally distributed variables, with the Bonferroni rule to correct for the inflation of Type I error due to multiple comparisons made. According to the Bonferroni rule, the p-value of each individual test was multiplied by the number of the post-hoc analyses. The associations between skewed variables and groups of participants were evaluated through the Kruskal-Wallis H-test. Associations between categorical variables were tested by the use of the chi-squared test. Furthermore, unadjusted and multinomial logistic regression analysis were used to evaluate the main effect of several parental and children's characteristics on childhood energy misreporting prevalence. Variables included into the model of multinomial logistic regression analysis were selected according to the results of unadjusted models (i.e., $p<0.05$) and as such to avoid collinearity. Results are presented as odds ratios (OR) and the corresponding 95% confidence intervals (CI). All reported p-values were based on two-sided test hypothesis and compared with a significance level of 5%. The SPSS v18.0 software was used for all statistical calculations (SPSS Inc, Chicago, IL, USA).

Results

Among participating children, 36% were classified as under-reporters and 16% as over-reporters. Children's anthropometric, dietary and lifestyle characteristics regarding their classification (i.e., under-, within plausible range and over-reporters) are presented in Table 1. Boys were more frequently over-reporting and less frequently under-reporting their energy intake compared to girls. Differences were evident regarding body weight, body weight perception and satisfaction, BMI, %BF, waist and hip circumferences, prevalence of overweight/obesity, and the prevalence of children spending more than 2 hours/day in front of a screen. Differences regarding energy intake and dietary habits according to children's classification, were evident between groups since under-reporters consumed breakfast less frequently than the rest of the two groups, while meals and snacks daily frequency was different between all groups (all p's<0.0001). In addition, over-reporters compared to under-reporters reported to consume more frequently whole wheat pasta (p<0.0001) and whole wheat bread (p=0.006), while no differences were shown regarding whole wheat cereals, cereal bars, brown rice, and whole wheat rusks consumption between the three groups. On the contrary, under-reporters when compared to over-reporters were more frequent consumers of low fat milk, yogurt, and cheese (all p's <0.0001), but not light soft drinks or mayonnaise (data not shown in Tables).

Table 1: Children's anthropometric, dietary, and lifestyle characteristics according to their energy intake reporting classification*

	N	Energy intake reporters			$P^{\dagger}$
		Under-reporters	Plausible range	Over-reporters	
%	4547	36	48	16	
Age (years)	4547	11 (0.72)	11 (0.73)	11 (0.74)	0.15
Boys (%)	4547	47	48	55	0.002
Body weight (kg)	4547	50 (12)	45 (10)	41 (8.7)	<0.0001
Deviance between the actual measured body weight and the perceived body weight (kg)	4378	0.90 (-0.50, 3.0)	0.40 (-0.80, 2.3)	0.00 (-1.3, 1.5)	<0.0001
Body Mass Index (kg/m^2)	4523	22 (4.0)	20 (3.6)	19 (3.8)	<0.0001
Percentage of body fat	4485	24 (9.0)	20 (8.5)	17 (7.7)	<0.0001
Waist circumference (cm)	4508	71 (9.9)	68 (9.3)	65 (8.2)	<0.0001
Hip circumference (cm)	4496	86 (10)	82 (9.7)	79 (8.8)	<0.0001
Waist-to-hip ratio	4487	0.83 (0.07)	0.83 (0.08)	0.83 (0.07)	0.51
Prevalence of overweight/obesity (%)	4523	55	37	21	<0.0001
PAQ-C score (1-5)	4445	2.9 (0.59)	3.0 (0.61)	3.0 (0.62)	0.20
Screen time equal or more than 2 hours / day (%)	4282	46.3	45.6	51.4	0.029
Energy intake (EI, kJ/day)					
Boys	2242	5050 (1309)	9418 (2105)	15610 (2460)	<0.0001
Girls	2305	4531 (1058)	8180 (1770)	14175 (2540)	<0.0001
Weekly consumption of breakfast	4298	4.18 (2.5)	4.6 (2.4)	4.6 (2.4)	<0.0001
Daily meals and snacks frequency	4379	2.93 (1.23)	3.16 (1.22)	3.49 (1.31)	<0.001
How content you are with your body weight [1 (Not at all) – 5 (Very content)]	4226				<0.001

1	17.4	11.2	10.5
2	18.5	12.3	9.3
3	27.9	27.3	21.8
4	18.4	22.8	23.6
5	17.8	26.3	34.8

[*] Normally distributed continuous variables are presented as mean (standard deviation) while skewed as median (25^{th} percentile, 75^{th} percentile), and categorical as frequencies.

[†] P-values were derived through comparisons between participants with categories of energy intake reporters using oneway ANOVA for normally distributed variables, Kruskall-Wallis H-test for skewed and Pearson's X^2 for categorical data.

With respect to parental characteristics, mothers of over-reporters tend to be less educated (p=0.01) (Table 2). In addition, both fathers' and mothers' type of occupation differed between the three energy reporters groups (all p's <0.001). Mothers of under-reporters had higher BMI compared to normal- (p<0.05) and over-reporters (p=0.003). In the case of over-reporters, having one parent overweight/obese was more frequent, while having both parents overweight/obese was more probable in under-reporters. The percentage of parents considering that their child's body weight was higher than normal, was higher among under-reporters, while on the contrary the proportion of parents considered that their child's body weight was lower than normal was higher in over-reporters (all p's<0.0001). Parents' perception concerning the quality of their children's diet was higher for the over-reporters, followed by plausible range energy reporters and under-reporters (all p's<0.0001). Additionally, under-reporters had rarely family meals, while over-reporters had more frequent family meals.

Table 2: Parents' socio-demographic, anthropometric and lifestyle characteristics according to energy intake reporting of their children*.

	N	Energy intake reporters Under-reporters	Plausible range reporters	Over-reporters	*P*
Paternal education (years)	1795	13.0 (4.1)	13.0 (4.2)	13.0 (4.3)	0.06
Maternal education (years)	1845	14.0 (3.5)	14.0 (3.7)	13.0 (3.8)	0.01
Fathers' BMI (kg/m^2)	1815	28.0 (3.4)	27.0 (3.6)	27.0 (3.7)	0.23
Mothers' BMI (kg/m^2)	1917	25.0 (4.2)	24.0 (3.7)	24.0 (4.4)	0.003
Parents' obesity status (%)	1766				0.02
None parent overweigh/obese		15.7	19.1	21.4	
One parent overweight/obese		52.9	52.1	57.2	
Both parents overweight/obese		31.4	28.8	21.4	
MedDietScore (0-55)	1977	28.0 (5.7)	28.0 (5.6)	28.0 (5.9)	0.80
Frequency of parents' physical activity with child (%)	1227				0.70
1 time/week		41.0	40	36	
2-3 times/week		43	44	47	
4-5 times/week		13	14	13	
≥6 times/week		2.1	3.2	4.4	
Parent's perception for children's:					
Body weight (%)	2068				<0.0001
Lower than normal		4.1	7.0	12.6	
Within normal range		60.5	72.3	72.7	
Higher than normal		35.4	20.7	14.7	
Parent's perception for children's quality of diet (0-10)	2040	7.3 (2.0)	7.5 (1.9)	7.8 (1.9)	0.001
Frequency of meals with the family (%)	2097				<0.0001
Never		1.5	1.8	2.1	
1-2 times/week		36.5	32.1	26.5	

3-4 times/week	21.4	17.0	20.9
5-6 times/week	8.2	11.9	7.1
Daily	32.4	37.2	43.5

* Normally distributed continuous variables are presented as mean (standard deviation) and categorical as frequencies.

† P-values were derived through comparisons between participants with categories of energy intake reporters using oneway ANOVA for normally distributed variables, and Pearson's X^2 for categorical data.

The effects of selected children's and parental anthropometric and lifestyle characteristics, as well as perceptions on the likelihood of misreporting are presented in Tables 3 and 4, respectively. Variables included into the models of multinomial logistic regression analysis were selected according to the results of unadjusted models (i.e., p<0.05) and as such to avoid collinearity. In the case of children' s characteristics logistic regression analysis showed that higher BMI was associated with higher likelihood of under-reporting. In addition, higher satisfaction with body weight decreased the likelihood of under-reporting, while the same effect in decreasing the likelihood of under-reporting had the increase in breakfast consumption frequency, and meals and snacks frequency. The habit of having family meals less than five times per week was associated with higher odds of being categorized as under-reporter. In the case of over-reporting, higher BMI, female gender, and having less than two hours of screen time/day were associated with lower likelihood of over-reporting. In contrast, increasing frequency of meals and snacks during the day was associated with higher odds of being categorized as over-reporter. With respect to parental characteristics, parents' perception of their child body weight was the significant predictor of under-reporting, and specifically the perception of having a child with normal or lower than normal body weight was associated with lower likelihood of under-reporting. Concerning over-reporting, higher maternal education was associated with lower likelihood of over-reporting and parental perception of having a child with a body weight lower than normal increased the likelihood of a child to be categorized as an over-reporter.

However, when all these factors entered into one multinomial logistic regression model, after controlling for all the factors presented in Tables 3 and 4, the only factors remaining significantly associated with the likelihood of under-reporting were BMI (OR 1.06; 95% CI 1.02, 1.11) and weight satisfaction (OR 0.88; 95% CI 0.79, 0.98). In the case of over-reporting, BMI (OR 0.84; 95% CI 0.78, 0.91), meals and snacks frequency (OR 1.53; 95% CI 1.33, 1.76), female gender (OR 0.64; 95% CI 0.45, 0.90), parental perception that the body weight of the child was normal (OR 0.52; 95% CI 0.30, 0.91), and maternal education (OR 0.95; 95% CI 0.90, 0.99) remained as significant predictors.

Table 3: Results of multinomial regression to evaluate the effect of children's anthropometric and lifestyle parameters on the prevalence of under- and over-reporting. Results are presented as odds ratios and 95%CI.

		Energy reporting		
	Under-reporters vs. Plausible range reporters		Over-reporters vs. Plausible range reporters	
	OR	95% CI	OR	95% CI
Gender				
Boys		1		1
Girls	1.01	(0.87, 1.18)	0.76	(0.63, 0.93)

Age	0.97	(0.87, 1.07)	0.94	(0.82, 1.08)
Satisfaction with body weight (1-5)	0.90	(0.85, 0.96)	0.96	(0.88, 1.04)
Meals and snacks frequency (per day)	0.92	(0.86, 0.97)	1.32	(1.22, 1.43)
Breakfast (times per week)	0.96	(0.93, 0.99)	0.97	(0.93, 1.01)
BMI (kg/m^2)	1.11	(1.09, 1.14)	0.87	(0.84, 0.90)
Screen time hours / day				
Equal or more than 2 hours per day		1		1
Less than 2 hours per day	1.02	(0.88, 1.18)	0.76	(0.65, 0.97)
Frequency of family meals				
5 or more time per week		1		1
Less than 5 times per week	1.24	(1.07, 1.44)	0.87	(0.71, 1.06)

All odds ratios and their corresponding 95% confidence intervals were calculated by performing multiple logistic regressions.

Table 4: Results of multinomial regression to evaluate the effect of parental anthropometric and lifestyle parameters on the prevalence of under- and over-reporting. Results are presented as odds ratios and 95%CI.

	Energy reporting			
	Under-reporters vs. Plausible range reporters		Over-reporters vs. Plausible range reporters	
	OR	95% CI	OR	95% CI
Parental obesity status				
Both parents OW/OB		1		1
None of the parents OW/OB	0.76	(0.54, 1.08)	1.21	(0.76, 1.91)
One parent OW/OB	0.94	(0.72, 1.21)	1.40	(0.96, 2.02)
Maternal education (years)	1.02	(0.98, 1.05)	0.96	(0.92, 0.99)
Perceived diet quality (0-10)	1.00	(0.94, 1.06)	1.09	(1.00, 1.19)
Perception of child's body weight				
Higher than normal		1		1
Lower than normal	0.37	(0.22 0.63)	2.32	(1.28, 4.20)
Normal	0.47	(0.36, 0.61)	1.24	(0.81, 1.90)

All odds ratios and their corresponding 95% confidence intervals were calculated by performing multiple logistic regressions

Discussion

Under the context of the GRECO (Greek childhood obesity) study, insight is provided into the issue of misreporting in children, in relation to anthropometric, adiposity (body fat measurement), dietary pattern (both individual as well as family), socio-demographic, and perceptional (individual as well as parental) parameters that seem to be related to the problem. Concerning the rates of misreporting, 36% of the children were classified as under-reporters and 16% as over-reporters. Similar high rates of misreporting have been documented in previous studies, with the problem becoming more frequent with increasing age, and especially among adolescents and girls [21-24]. In the present study, under-reporting was higher among girls, but over-reporting was more evident in boys. Although comparisons of the prevalence of misreporting of energy intake between studies are difficult because of differences in the criteria used to classify under- and over-reporters, dietary assessment methods, number of assessment days and population characteristics, our findings suggest that not only under-reporting (URP) but also over-reporting (ORP) of energy intake should be considered as a serious problem in studies which include children and adolescents, although the prevalence of URP is reported to be usually higher than ORP [7].

Under-reporting children besides having grater body weight and BMI values, also had higher percentage of body fat mass, waist and hip circumferences [23,25,26,27]. On the other hand, over-reporters were less likely to be categorized as overweight/obese, had lower body weight and BMI, as well as lower adiposity, and central or peripheral adiposity markers. These results demonstrate that it is not only body weight and BMI that affects the accuracy of dietary energy reports, but also the body shape and particularly the degree of leanness or adiposity that affects the perceived level of fatness [28,29]. It should also be mentioned that the age of the participants is the late childhood and pre-adolescence, a period of rapid growth in which boys and girls increase fat-free mass substantially, and in girls is associated with considerable increase in body fat-mass [(29)]. Interestingly, under-reporting children had the biggest difficulty in estimating correctly their body weight, while over-reporters were much more accurate. This latter finding does not necessarily show a superior ability of the over-reporting children, but probably a tendency of under-reporting children to report a more desirable (i.e. lower) value of body weight. As shown in Table 1, under-reporters had significantly higher levels of weight concern and dissatisfaction since a higher proportion of under-reporters stated to be less content with their body weight. In contrast, a significantly higher proportion of over-reporting children were found to be satisfied with their body weight.

According to the multinomial regression analysis, children's BMI, weight satisfaction, breakfast and meals and snacks frequency, as well as family meals frequency were factors associated with URP (Table 3). However, when children's and parental factors entered into one multinomial logistic regression model, the only two factors that remained significantly associated with under-reporting were BMI and weight satisfaction. Consistent with several previous reports overweight and obese participants were more likely to under-report their energy intake [(23,25-28, 30)]. This finding may be related with the tendency of URP children to deliberately omit characteristics of their diet and report habits more consistent with perceptions of what comprises a healthy, balanced or acceptable diet, irrespectively of what their actual dietary habits are. Before adjustment for parental confounders our results showed that the habit of having breakfast, and the higher number of meals and snacks during the day, were inversely associated with the prevalence of URP which has been shown in previous studies as well [(22, 32, 33)]. Concerning specific foods intake, URP children reported higher preference in low-fat dairy foods (milk, yogurt, cheese), which could be assumed to be the result of selective reporting of foods which are considered to be more appropriate for maintaining weight balance or even perceived as healthier. Similarly, in the study of Börnhorst *et al*. [30] foods commonly perceived as unhealthy (chocolate products, soft drinks etc.) were negatively associated with URP while fruit and vegetables intake showed a positive association. Regardless of the reason, as it has been previously shown the vast majority of children in this age group have good nutritional knowledge and therefore can distinguish between "bad” or “good" dietary choices and therefore may adjust their answers during a dietary survey [34]. The protective effect of frequent family meals on URP which was not confirmed in the fully adjusted multinomial regression analysis, is a novel observation and as far as we know this finding has not been previously shown in the literature, and therefore cannot by commented.

The risk of ORP was found to be decreased in girls, and also decreased with increasing BMI, and with less engagement in sedentary activities (less than 2 hours screen time/day), but was positively associated with meals and snacks frequency. Yet, when adjusting for all children's and parental factors the parameters that remained negatively associated with ORP were BMI, female gender, parental perception regarding their child's body weight status (specifically perceiving it normal), and maternal education level. Furthermore, meals and snacks frequency were positively associated with higher likelihood of over-reporting. Previous studies have shown conflicting results regarding the prevalence of ORP in boys and girls [21, 25]. However, the negative association between BMI and ORP has been shown in other studies [21,25, 30] and may be explained by the hypothesis that children who are leaner, might want to mask what they believe or have heard to be an excessively low intake [31]. In addition, as revealed in our results parental perception about their children's body weight status seem to affect the odds of a child to over-report. Among over-reporting children, a significantly higher proportion of their parents considered that their child's body weight was lower than normal. It is widely recognized that parents affect the family health awareness and play a direct role in shaping children's eating habits [35,36]. Moreover, they affect the consciousness concerning the potential problem of childhood overweight/obesity or underweight. Therefore, it could be hypothesized that parental opinion on their child's weight and diet, may have influenced the accuracy of their children' s provided dietary data towards, as conceived by the children, more appropriate or acceptable food choices and dietary practices, according to the principles given at home. Lastly, in agreement with previous studies, it was also shown that low maternal education was associated with energy misreporting [25,37], although there is no consensus regarding the socioeconomic correlates on this matter [22].

The validity of reported energy intake is often assessed by comparing energy intake to total energy expenditure. At present, the only way to obtain unbiased information on energy requirements in free-living settings is to use doubly labeled water as a biomarker [3,4]. However, this technique is expensive and impractical for the application to large-scale epidemiologic studies. Thus, the Goldberg approach was used alternatively, in order to identify energy misreporters [16]. There are a number of assumptions and limitations pertaining to the Goldberg cut-offs. The Goldberg equations assume that body weight is stable, which may not be the case for growing children in which the extra amount of energy is required for growth. Additionally, we cannot exclude the possibility that some plausible range reporting individuals might have been misclassified as over-reporters of energy intake because of rapid growth and actual high energy intakes, as well as the fact that some of the children classified as under-reporters may be really under-eating or dieting [38]. Furthermore, there are important measurement issues that may influence reporting accuracy when children or adolescents are evaluated. These issues include difficulties in remembering the foods consumed, food recognition, and portion size estimation [6]. The studied age group of pre-adolescents is often characterised by irregular dietary patterns, eating occasions, and snacking frequencies, and therefore might be more prone to forgetting foods or drinks consumed [22,23]. Furthermore, we cannot omit the refer to the reverse causality effect, since the characteristics associated with biased reporting in children (i.e. breakfast skipping, less meals and snacks, body weight dissatisfaction and concern), could be due to the strong association of URP with overweight/obesity and the fact that these kind of characteristics are frequently seen in overweight/obesity children as well. However, as can be seen in Tables 3 and 4, all regression models were adjusted for BMI.

Another important limitation is the low response rate of the parental questionnaires, which may have introduced respondent bias from lower socio-economic groups that are more likely to be either non-responders in survey research, and overweight or obese [39]. However, in order to check for any bias regarding the data analyses, we compared the BMI and the prevalence of miss-reporting of the two groups (i.e. children with and without parental information) and found no differences.

In conclusion, the present study confirms that the issue of under- and over-reporting in childhood populations is evident, can be quite serious, and may distort our understanding of the relation between dietary factors and health status. Although there are no clear guidelines on how to use data obtained from energy misreporters in an epidemiological dataset (i.e. discarding or keeping them), there is a clear need to identify the characteristics of children that misreport. The most robust findings of the present study was the association between misreporting and BMI, and body weight dissatisfaction. Finally, in both cases of under- and over-reporting, data accuracy was probably influenced by the need to report socially acceptable habits and patterns, as well as parental perceptions regarding their children's weight status.

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Conflict of Interest

None.

Authorship

A.Z., D.B.P., G.R. and P.F. were responsible for the study design and the supervision of the field study. V.B., D.B.P., and P.F. were responsible for the statistical analysis. P.F., D.B.P, G.R. and A.Z. were responsible for the interpretation of the data. All authors carried out data management, contributed to database preparation and participated in writing the final version of the submitted manuscript.

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PAPER VI

Magriplis E, Farajian P, Pounis GD, Risvas G, Panagiotakos DB, Zampelas A. High sodium intake of children through 'hidden' food sources and its association with the Mediterranean diet: the GRECO study. *J Hypertens* 2011; 29:1069-76.

High sodium intake of children through 'hidden' food sources and its association with the Mediterranean diet: the GRECO study

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Objectives **Sodium is the mineral that has been, mainly, linked to hypertension and cardiovascular disease. It is found naturally in many foods, but is also used in the food industry and manufacturing. Identification of total sodium intake, as well as 'hidden' sodium intake from food sources early in life is necessary.**

Methods **Four thousand, five hundred and eighty children aged 10–12 years were enrolled, in a cross-sectional, population-based survey. Among other measurements, dietary data were obtained by a semi-quantitative food frequency questionnaire, and sodium intake was calculated. High sodium consumption was considered an intake over 2200 mg/day. Adherence to the Mediterranean dietary pattern was evaluated using the Mediterranean Diet Quality Index for children and adolescent score (KIDMED score).**

Results **Twenty-three percent of Greek children had sodium intake which exceeded the 2200 mg/day recommendation, excluding salt added at table and during cooking. Sodium intake was found elevated in children with moderate and high adherence to the Mediterranean Diet. Additionally, 1 unit increase in KIDMED score (i.e. higher adherence) was associated with 10% [odds ratio (OR) 1.10, 95% confidence interval (CI) 1.07–1.13] increased likelihood of consuming sodium above the median intake (i.e. >1500 mg/day). Thirty-four percent of sodium intake from 'hidden' sources came from bread, processed cereals and white cheese.**

Conclusions **Greek children have an elevated sodium intake from 'hidden' sources and main contributors are foods which are recommended to be consumed on a daily basis according to the Mediterranean Diet Pyramid. These findings should induce manufacturers to reduce the amount of sodium added during processing of 'healthy' foods, especially bread and cheese.** ***J Hypertens*** **29:1069–1076**

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Keywords: children, Mediterranean diet, public health, sodium food sources, sodium intake

Abbreviations: FFQ, Food Frequency Questionnaire; KIDMED, Mediterranean Diet Quality Index for children and adolescents; MVPA, moderate through vigorous physical activity; PAQ-C, Physical Activity Questionnaire for older Children

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Introduction

Hypertension is a global burden which has been associated with renal and cardiovascular disease, the latter being the leading cause of death in developed countries. Worldwide, nearly 1 billion adults have hypertension, and 17–30% of hypertension cases can be attributed to excess dietary sodium [1,2]. Sodium is a mineral found naturally in many foods but is also used greatly in processed foods. It is noteworthy that in some countries, it has been suggested that reducing sodium consumption to the recommended intakes (<2200 mg/day) will likely reduce hypertension and hypertension-related cardiovascular disease by 30 and 8.6%, respectively [3]. High blood pressure (BP) levels can be observed in children and a significant number of children have elevated BP levels without having any underlying disease. High BP levels in childhood should be regularly reassessed and nonpharmacological or pharmacological interventions should be promptly initiated because high BP levels in childhood may lead to hypertension and related cardiovascular diseases in later life [4].

Regarding sodium intake modification, there is controversy as to how sodium intake can be decreased in individuals, as well as in populations, and which public health measures should be taken in order to help reduce total sodium daily intake. Therefore, identification of food sources of sodium in modern diets is critical. To date many researchers have focused on the sodium content of poor nutritional quality foods that children consume [5]. Sodium, however, can also be found hidden in 'healthy' foods such as whole wheat bread and processed cereal, foods consumed largely in a Mediterranean-type diet. Although the health benefits of the Mediterranean diet are widely acknowledged, there is still inconsistency regarding the association of adherence to the Mediterranean diet and total sodium intake. In particular, the

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Mediterranean diet has been described as a diet abundant in plant foods, minimally processed, olive oil as the main fat source, low to moderate dairy and wine intake, low intake of red meat, and sparse sugar intake [6]. Although research has shown that specific foods which characterize the Mediterranean diet have preventive effects on chronic diseases, such as fruits and vegetables, olive oil and nuts and unprocessed cereals [7–16], little is known on the contribution of these foods to the total sodium intake in the modern diet.

Therefore, in the present work, and under the context of the Greek Childhood Obesity study (GRECO), the daily dietary sodium intake (excluding table salt and salt added during cooking) of 10–12 years old Greek children, was studied, within the context of the Mediterranean diet pattern.

Methods

Participants

The GRECO study was carried out from October to May 2009. The sampling included all regions of the country (i.e. Attica, Sterea Ellada and Evia, Macedonia, Peloponnesus, Epirus, Thessaly, Thrace, Aegean islands, Ionian Islands and Crete). From the aforementioned regions a number of 130 randomly selected public primary schools (through the listings provided by the Ministry of Education) were invited to participate. The number of children to be enrolled in each region was proportional to the total population of the region, based on data provided by the National Statistics Service of Greece. Thus, a total of 5850 schoolchildren (fifth and sixth grade) were invited for potential inclusion. However, the number of schools that agreed to participate in the study was 117 from all over the country and signed parental consent forms were obtained for 4965 of 5850 children (84.9% participation rate) and were finally enrolled in the study. After checking the quality of the data obtained from the enrolled children, the final sample consisted of 4580 children (49% men and 51% women) with a mean age of 10.9 ± 0.75 years, with the 52.0 and 48% coming from large urban (i.e. >1 000 000 pop.) and urban and semi-urban areas (i.e. 10 000 to 1 000 000 pop.), respectively.

Bioethics

The retrieved data were confidential, and the study followed the ethical considerations provided by the World Medical Association (52nd WMA General Assembly, Edinburgh, Scotland, October 2000). The research was approved by the Hellenic Ministry of Education (Department of Primary Education) as the law provides in Greece for any studies conducted in the school environment, during formal school hours, and the Agricultural University of Athens Research Committee. Prior to measurements' initiation an extended letter explaining the aims of the study was sent to the principal of each school and each parent or guardian was provided with a letter explaining the aims of the study and a consent form. Those parents who agreed to participate in the study had to sign the consent form and send it back to the school in order to be collected.

Measurements

The measurements were conducted by investigators and staff of the Unit of Human Nutrition of the Agricultural University of Athens. All investigators followed a series of planning meetings and were trained in survey methods that included practical experience in weighing and measuring techniques. Additionally, before the initiation of the study all investigators followed a 2-week pilot practice period in primary schools that were not included in the final study sample in order to get familiarized with the procedures. All study sites used the same measuring equipment and procedures and in each class the investigators' team consisted of at least two people. All measurements were performed during morning hours.

Dietary and eating behavior assessment

Dietary assessment was based on a validated self-reported, semi-quantitative Food Frequency Questionnaire (FFQ), consisting of 48 food items commonly used in the local Greek cuisine [17]. All participants were asked about their usual frequency of consumption of the food items (average over the past year) with the response categories ranging from never, 1–2 times per month, to everyday. Pictures of standard size of the food portions were used to help participants visualize the regular portion and quantify the portion of the food item they usually consumed. Specifics on the type of food consumed were also asked for (such as whole wheat bread vs. white bread, brown rice vs. white, low-fat dairy products vs. full-fat, sugar-free soft drinks vs. regular, etc.). The assessment of sodium intake through consumption of various food groups was performed using food composition tables of US Department of Agriculture [18]. The evaluation of repeatability of dietary information regarding sodium intake were tested in a sample of 21 girls and 23 boys (aged 10–12 years) from one school unit in Athens, applying the semi-quantitative FFQ two times (within a 30-day interval) in the same children. Results showed very good repeatability between the two measurements (Spearman's rho $= 0.82$, $P < 0.001$, % of agreement using Bland–Altman graphical method $= 93.2\%$). Furthermore relative validity of such information was assessed using 3-day recalls which applied 30 days after the FFQ in a second sample of 20 girls and 13 boys (aged 10–12 years) from the same school unit. Very good relative validity was revealed regarding sodium consumption resulting from FFQ and 3-day recalls (Spearman's rho $= 0.57$, $P < 0.001$, % of agreement using Bland–Altman graphical method $= 91.0\%$).

Assessment of Mediterranean diet pattern

The KIDMED index (Mediterranean Diet Quality Index for children and adolescents) was used to evaluate the degree of adherence to the Mediterranean diet [19]. The index comprises of 16 yes or no questions. Questions denoting a negative connotation with respect to the Mediterranean diet were assigned a value of −1 and those with a positive aspect +1. The total score ranged from −4 to 12.

Physical activity, anthropometric assessment and blood pressure measurements

All participants were asked to complete the Physical Activity Questionnaire for Older Children (PAQ-C) [20]. The instrument is designed for use in older children aged 8–14 years and consists of nine questions structured to discern moderate to vigorous physical activity (MVPA) during the past 7 days. The summary score for the PAQ-C is the average of the sum of the nine questions using a 1–5 scale and it is designed to be used during the school year, rather than summer vacation or holiday periods.

Body weight was recorded to the nearest 100 g with the use of a digital scale (Tanita TBF 300) and with patients standing without shoes in light clothing. Standing height was measured using a portable stadiometer (Leicester height measure) to the nearest 0.1 cm without shoes, with the head positioned according to the Frankfort plane. Body mass index (BMI) was calculated by dividing weight (kg) by standing height squared (m^2). Percentage of body fat (%BF) and body fat mass were estimated by the foot to foot impedance method (Tanita TBF 300) with children standing barefoot. Obesity and overweight among children were evaluated using the International Obesity Task Force (IOTF) age and sex-specific BMI cut-off criteria [21].

Blood pressure was measured using an oscillometric device (UA-787 oscillometric blood pressure monitor, A&D Company), equipped with the right type of cuff for children of this age. During the measurements children were calm, in a sitting position with their back supported, with the right arm resting on a solid supporting surface at heart level, and at least 10 min at rest [22]. Two subsequent measurements were taken with a 5-min interval in order to familiarize children with the procedure and the diastolic and systolic BP values of the second measurements were recorded.

Statistical analysis

Normally distributed continuous variables are presented as mean ± SD, skewed as median (first, third quartiles) and categorical variables as frequencies. The normality of continuous variables was tested graphically according to P-P plots. Comparisons of continuous variables between groups of study were performed using the independent *t*-test or one-way ANOVA, for the normally distributed variables and the Mann–Whitney *U*-test or Kruskal–Wallis test, for the skewed. Associations between categorical variables were tested using the Pearson's chi-squared test. Repeatability and relative validity of dietary information regarding sodium intake were tested using Spearman's rho and Bland–Altman method. High sodium consumption was considered over 2200 mg/day from food sources alone [23]. According to the KIDMED scoring system [19], only 4.5% of the children ($N = 205$) had an optimal score (≥8), therefore children with average and high scores were pooled together into one group of 'moderate and high adherers' to the Mediterranean diet, with a KIDMED score higher than the median for this population (i.e. >4). Whereas children with a KIDMED score equal or lower than the median were classified as 'low adherers'. Multiple logistic regression analysis adjusted for age, sex, BMI and physical activity was used to evaluate the association between adherence to the Mediterranean diet on the likelihood of consuming high sodium intake from different food resources (dependent outcome). Results are presented as odds ratios (ORs) and their corresponding 95% confidence intervals (CIs). Hosmer–Lemeshow statistic was used to test the models' goodness of fit. All tested hypotheses were two-sided. *P*-value less than 0.05 was considered as statistically significant. SPSS version 18 software was used for all calculations (SPSS Inc., Chicago, Illinois, USA).

Results

In Table 1 various socio-demographic, anthropometric and lifestyle characteristics of the children are presented, according to their level of sodium intake, other than table salt. Using the recommended cut-offs it was observed that 23% of the total sample had high sodium intake (>2200 mg/day), without taking into account added salt at the table or while cooking. Moreover, boys were more likely to be categorized in high sodium consumption than girls ($P < 0.001$); 31.6% of children who had high total sodium consumption were overweight or obese; children with high sodium intake were more physically active, but also had better adherence to the Mediterranean diet than participants with low intake. No significant difference was observed as regards the level of sodium intake and age groups, or region of living (urban or rural). Moreover, no association was observed between sodium intake and BP levels, even after adjusting for sex and age of the children. Concerning body fat measurement results, body fat mass was positively correlated with BMI (Pearson's rho = 0.897, $P < 0.001$), and negatively correlated with sodium intake (Spearman's rho = −0.180, $P < 0.001$).

Then, increased sodium intake from different food sources was evaluated by the level of adherence to the Mediterranean diet (Table 2). Children that reported moderate and high adherence to the Mediterranean diet (i.e. KIDMED score >4) had higher sodium intake from the majority of the food groups ($P < 0.001$), by the exception of pizza, hamburgers, souvlaki (a type of meat), saltines (including crisps, crackers, cheese sticks) and cakes ($P > 0.05$).

Table 1 Socio-demographic, anthropometric and lifestyle characteristics of the participants, by sodium consumption from foods other than table salt and cooking salt

	Low total sodium intake (<1500mg/day)[a]	Moderate total sodium intake (1500–2200 mg/day)	High total sodium intake (>2200 mg/day)	Total sample	P^b
N	2570 (56.1%)	959 (20.9%)	1051 (23%)	4580	
Age group (%)					0.14
10 years	25.2	21.6	22.5	23.6	
11 years	47.6	49.7	48.2	48.3	
12 years	27.2	28.7	29.3	28.1	
Male sex (%)	42.2	48.9	60.3**	49.0	<0.001
BMI (kg/m^2)	20.7 ± 3.9	20.2 ± 3.7	19.5 ± 3.6*	20.3 ± 3.8	<0.001
Body fat mass (kg)	11.2 ± 6.6	10.3 ± 6.3	8.9 ± 5.8	10.4 ± 6.4	<0.001
Percentage of body fat (%)	22.4 ± 8.9	20.8 ± 8.7	18.8 ± 8.3	21.1 ± 8.9	<0.001
Overweight/obese (%)	45.0	39.6	31.8**	40.1	<0.001
Physical activity (0–5)	2.92 ± 0.60	2.93 ± 0.58	3.02 ± 0.62*	2.95 ± 0.60	<0.001
KIDMED score (−4 to 12)	3.55 ± 2.17	4.21 ± 2.12**	3.86 ± 2.25*	3.78 ± 2.20	<0.001

[a] Total dietary sodium consumption was classified to low, moderate and high intake (i.e. <1500, 1500–2200, >2200 mg/day) using European Union recommendations. [b] *P* values were derived through one-way ANOVA test for normally distributed variables, Kruskal–Wallis for skewed and Pearson's χ^2 for categorical data. * $P < 0.05$ from post-hoc comparisons between high, moderate vs. low sodium intake, after correcting the *P* value with the Bonferroni rule. ** $P < 0.01$ from post-hoc comparisons between high, moderate vs. low sodium intake, after correcting the *P* value with the Bonferroni rule.

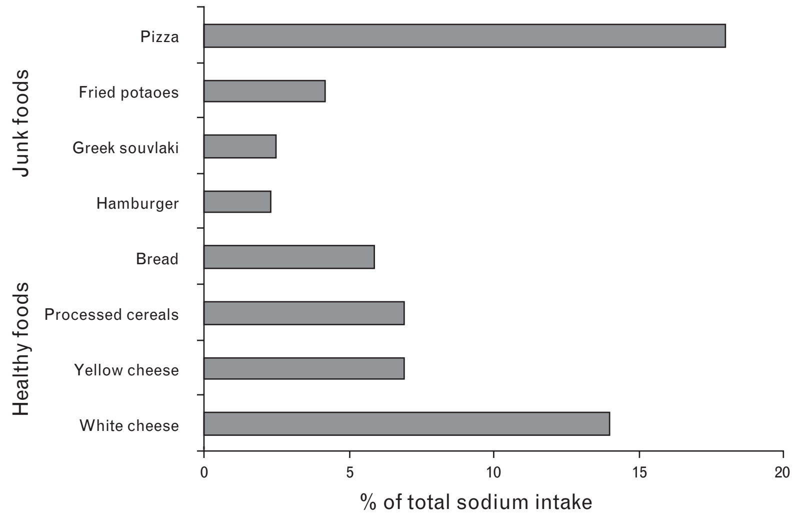
Moreover, in Fig. 1, the major food items that contribute to sodium intake are presented. The greater sources of sodium in children's diet were pizza and white cheese, whereas healthy foods, conferred more in total sodium consumption than junk foods (34 and 27% of total sodium intake, correspondingly). It should be noted that children with moderate and high adherence to the Mediterranean diet (i.e. KIDMED score >4) had higher consumption of

Table 2 Sodium intake from different sources, by level of adherence to the Mediterranean diet using KIDMED score

	Low adherence to Mediterranean diet	Moderate and high adherence to Mediterranean diet	Total sample	P^a
N	2876	1704	4580	
Sex (%)				0.257
Boys	61.9	38.1	49.0	
Girls	63.5	36.5	51.0	
Weight status (%)				0.348
Overweight	64.1	35.9	29.1	
Obese	63.6	36.4	11.0	
BMI (kg/m^2)	20.3 ± 3.8	20.2 ± 3.8	20.3 ± 3.8	0.311
Percentage of body fat (%)	21.2 ± 8.9	20.8 ± 8.8	21.1 ± 8.9	0.193
IPAQ-C	2.9 ± 0.6	3.0 ± 0.6	2.9 ± 0.6	<0.001
DBP (mmHg)	71.2 ± 10.6	70.9 ± 10.4	71.1 ± 10.5	0.47
SBP (mmHg)	108.5 ± 13.0	108.1 ± 13.0	108.4 ± 13.0	0.39
Sodium intake from different food groups (mg/day)[b]				
Processed cereals	29.6 (0, 133)	104 (29.6, 207)	59.2 (10.4, 133)	<0.001
Bread	53.2 (4.7, 120)	59.8 (26.6, 138)	53.2 (9.32, 120)	<0.001
Beans	2.8 (0, 8.3)	11 (2.9, 16.6)	5.5 (0.97, 11)	<0.001
Potatoes	46.4 (16.2, 139)	92.8 (32.5, 186)	48.7 (16.2, 48.7)	<0.001
Bread products	7.3 (0, 18.8)	14.6 (3.6, 29.2)	7.3 (2.55, 29.2)	<0.001
Cabbage family	0 (0, 3.5)	2.5 (47.9, 431)	1.2 (0, 3.5)	<0.001
Cheese, white	95.8 (0, 335)	215 (47.9, 431)	95.8 (16.8, 335)	<0.001
Cheese, yellow	41.5 (0, 166)	82.9 (14.5, 187)	41.5 (0, 166)	<0.001
Cheese, low in fat	0 (0, 13.2)	4.6 (0, 26.3)	0 (0, 13.2)	<0.001
Cold cuts (processed meat)	55.8 (0, 223)	55.8 (19.5, 223)	55.8 (9.8, 223)	<0.001
Meat, red	10 (3.5, 20)	20 (7, 40)	10 (3.5, 20)	<0.001
Meat, white	13.6 (6.8, 38.8)	19.4 (13.6, 38.8)	19.4 (6.8, 38,8)	<0.001
Fish	14 (4.9, 28)	28 (9.8, 42)	14 (4.9, 28)	<0.001
Pizza	188 (65.8, 376)	188 (132, 376)	188 (65.8, 376)	0.34
Hamburger	26.6 (0, 26.6)	26.6 (0, 26.6)	26.6 (0, 26.6)	0.56
Souvlaki	14.4 (14.4, 41)	14.4 (14.4, 41)	14.4 (14.4, 41)	0.58
Potatoes, fried	27.7 (9.7, 83.2)	41.6 (19.4, 111)	27.7 (9.7, 111)	<0.001
Saltines	38.1 (0, 109)	38.1 (19.1, 109)	38.1 (0, 109)	0.38
Cake	23.2 (11.6, 66.4)	31.1 (11.6, 66.4)	23.2 (11.6, 66.4)	0.12
Pies	18.1 (0, 51.8)	45.3 (18.1, 10.4)	18.1 (18.1, 104)	<0.001
Soft drinks	1.4 (0, 8)	2.0 (1.4, 8.0)	1.4 (0, 8)	<0.001
Total sodium intake (mg/day)	1410 (839, 2258)	1576 (1091, 2330)	1481 (932, 2287)	<0.001
Total sodium intake (%)				<0.01
<1500 mg/day	57.7	53.4	56.1	
1500–2200 mg/day	19.2	23.9	20.9	
≥2200 mg/day	23.1	22.6	23.0	

Low MD adherence: KIDMED score ≤4; moderate and high MD adherence: KIDMED >4. [a] *P* values were derived using Mann–Whitney test for skewed variables and Pearson's χ^2 for categorical data. [b] Dietary sodium intake from different sources is presented as median (25th percentile, 75th percentile) because its distribution was skewed in all cases.

Fig. 1



Sodium intake from healthy or junk foods as percentage of total consumption other than table salt and salt added during cooking.

these foods (P values for all <0.05), with the exception of pizza, hamburgers and souvlaki.

In addition, the level of adherence to the Mediterranean diet was associated with sodium intake from various food sources. In particular, unadjusted analyses (Table 3) revealed that 1 unit increase in the KIDMED score was associated with 4–50% (i.e. ORs varied from 1.04 to 1.50, all P values <0.05) increased likelihood of consuming sodium intake above the median value for the majority of foods. These results were confirmed even after adjusting for age, sex, BMI and physical activity. The impact of healthy dietary habits (as assessed through the KIDMED score) on the likelihood of high sodium intake were not significant regarding hamburgers and saltines (P values >0.05). Moreover, 1 unit increase in

Table 3 Results from multiple logistic regression analyses that evaluated the association between children's adherence to the Mediterranean diet (using the KIDMED score as independent variable) on likelihood of consuming high sodium (i.e. above the median as the binary dependent outcome) from different food sources (other than table and cooking salt)

	Unadjusted		Adjusted for age, sex, physical activity and BMI	
Sodium higher than the median intake from various foods[a] (dependent)	OR for 1 unit in KIDMED	95% CI	OR for 1 unit in KIDMED	95% CI
>59.2 mg/day from processed cereals	1.32*	1.28, 1.36	1.31*	1.27, 1.35
>53.2 mg/day from bread	1.20*	1.17, 1.24	1.20*	1.17, 1.23
>7.3 mg/day from bread products	1.22*	1.19, 1.25	1.20*	1.17, 1.24
>5.5 mg/day from beans	1.50*	1.45, 1.55	1.50*	1.45, 1.55
>48.7 mg/day from potatoes	1.19*	1.16, 1.23	1.18*	1.15, 1.22
>1.2 mg/day from cabbage family	1.30*	1.26, 1.33	1.29*	1.26, 1.33
>95.8 mg/day from white cheese	1.26*	1.23, 1.30	1.25*	1.22, 1.29
>41.5 mg/day from yellow cheese	1.19*	1.16, 1.22	1.18*	1.15, 1.21
>0.1 mg/day low in fat cheese	1.13*	1.10, 1.16	1.12*	1.09, 1.15
>55.8 mg/day from cold cuts	1.09*	1.06, 1.11	1.08*	1.05, 1,11
>10 mg/day from red meat	1.18*	1.15, 1.21	1.16*	1.13, 1.20
>19.4 mg/day from white meat	1.19*	1.16, 1.23	1.18*	1.15 1.22
>14 mg/day from fish	1.35*	1.31, 1.39	1.33*	1.30, 1.38
>188 mg/day from pizza	1.04*	1.01, 1.06	1.04*	1.01, 1.07
>26.6 mg/day from hamburger	0.99	0.96, 1.02	0.99	0.96,1.02
>14.4 mg/day from souvlaki	1.23*	1.19, 1.28	1.23*	1.18, 1.27
>27.7 mg/day from fried potatoes	1.13*	1.10, 1.16	1.13*	1.10, 1.16
>38.1 mg/day from saltines	1.02*	1.00, 1.05	1.02*	0.99, 1.04
>23.2 mg/day from cake	1.07*	1.04, 1.10	1.06*	1.03, 1.09
>18.1 mg/day from pies	1.10*	1.07, 1.13	1.10*	1.07, 1.13
>1.4 mg/day from soft drinks	1.12*	1.09, 1.15	1.10*	1.07, 1.14
Total sodium intake over EU upper level (>1500 mg/day)	1.10*	1.07, 1.13	1.10*	1.07, 1.13
Total sodium intake over EU recommended consumption (>2200 mg)	1.02	0.99, 1.05	1.02	0.98, 1.05

[a] Sodium intake over the median for this population was evaluated as high consumption for each food group. * $P < 0.05$.

KIDMED score was associated with 10% increase in likelihood of consuming total sodium greater than 1500 mg/day (which is the EU upper level), although this association was not significant when extreme total sodium intake (i.e. >2200 mg/day) was considered as the outcome ($P > 0.05$). At this point it should be noted that the average level of adherence to the Mediterranean diet was low to moderate in both sexes (Table 1).

Discussion

The main finding of the present work was that dietary sodium intake, other than table salt and salt added during cooking, is above the current guidelines in 23% of the Greek children. A secondary finding was that this high sodium intake was observed even in children that reported to be closer to the Mediterranean dietary pattern. Nevertheless, it should be underlined that only 4.5% of children had an optimal adherence to the Mediterranean diet (KIDMED score ≥8). These extremely low levels of adherence imply that the positive association between dietary sodium intake from food sources and the adherence to the Mediterranean diet scheme, basically concerns children with low and moderate adherence to this traditional dietary pattern, although the main contributors of sodium intake were foods which are recommended to be consumed on a daily basis and are placed at the bottom of the pyramid. Finally, another important finding of the GRECO study was the alarming magnitude of childhood obesity in Greece, since the overall prevalence of overweight and obesity exceeded 40% of the population of schoolchildren aged 10–12 years.

In addition, the fact that a further 20.9% of the children had a moderate sodium intake (between 1500 and 2200 mg/day), but only via foods, and without taking into account the salt added at the table and the salt added during cooking, could imply that a significant and alarming proportion of the children consumes sodium above the guidelines, which makes it an important public health issue, in Greece. Sex and physical activity were also associated with high sodium consumption. In particular, boys and physically active children had higher sodium intakes than girls and less physically active children. The key sodium contributors were pizza, white cheese, processed cereals and breads.

Our results are in agreement with results from studies performed in other countries too [24–27]. In particular, Pavadhgul *et al.* [26] found that dietary sodium intake among Thai University students was two-fold higher than recommended amounts (>2400 mg) and Fischer *et al.* [24] found an average sodium intake of 3412 mg in youths aged 9–18 years with the key food contributors being breads, processed meats and pasta dishes. This was further supported by other studies [25,28].

It is of great interest that children closer to the Mediterranean diet reported a higher sodium intake, whereas a greater proportion of overweight/obese children reported low sodium intake. This may partly be explained by the possible under-reporting seen of overweight/obese individuals; although the questionnaires repeatability was validated prior to use. It must be noted that moderate and high KIDMED score (>4) was observed in 38.8% of overweight/obese children compared to 61.2% of normal weight children. No differences were observed in the mean physical activity index score between these groups of children (data not shown).

In this work we quantified the association between the level of Mediterranean diet adherence and sodium intake by calculating the OR of exposure, in order to better evaluate the main effect of the dietary habits of the participants on the likelihood of consuming higher quantities of sodium from different foods. A strong association between the level of adherence to Mediterranean diet and sodium intake was observed. This may seem controversial after taking into consideration that adherence to a Mediterranean food pattern has been shown to be associated with substantial reductions in total mortality and cardiovascular disease mortality in adults [7–10]. In addition, studies have also found an inverse association between hypertension incidence, as well as BP levels in individuals following the Mediterranean diet [11,12]. Moreover, it has also been observed that a diet high in olive oil and, fruit and vegetable was inversely associated with hypertension [13] and that a dietary pattern rich in fruit, vegetables, and low-fat dairy products and poor in total and saturated fat can be effective in the prevention of hypertension [14,29]. However, Núñez-Córdoba *et al.* [16] did not find an association between hypertension and adherence to the classical Mediterranean diet.

A possible explanation of the high sodium intake of children with moderate and high Mediterranean diet adherence is the total food intake. Thirty-four percent (34%) of total sodium intake was found to be consumed by those foods known as 'healthy' (i.e. bread, processed cereal and white cheese), compared with 18% that was observed from pizza. These foods which are recommended to be consumed on a daily basis seem to add substantially to the total dietary sodium of an otherwise healthy dietary pattern, due to sodium addition during manufacturing. Processed foods, including breads/cereals/grains, also contributed heavily to sodium intake in the UK (95%) and the US [25]. It is estimated that approximately 75% of dietary sodium is added during food processing; in addition to taste and palatability, sodium also has functional roles in food manufacturing and preservation, although the amounts used often exceed those required [30]. Due to the high consumption, it may be necessary for manufacturers to reduce sodium use. It has been proposed that the most promising sodium reduction strategy is to adapt the preference of consumers for saltiness by reducing sodium in products in small steps [31].

Lastly, it must be noted that our results include the overall population and are not confined on high-risk individuals only (i.e. obese children). Studies have found a direct relation between the increase in childhood obesity and the increased prevalence of pediatric hypertension [32]; also sodium has been associated with an increase in BP, direct cardiovascular damage and obesity [33]. The evaluation of total sodium intake from foods alone (excluding table and cooking salt) in this study showed that both obese and normal weight children have a high dietary sodium intake, raising important public health questions for the children's population. Although, sodium intake was not associated with BP levels, the fact that 23% of the children's population exceeded the current guidelines from food sources alone makes them exposed to higher risk for future development of hypertension. It is also noteworthy that BMI was positively correlated with BP levels, indicating that children of these age groups are susceptible to risk factors that are documented to elevate BP levels [22,34]. Since the age-related BP rise in both children and adults is well established [34], efforts to reduce sodium intake and decrease the very high prevalence of childhood obesity, which were observed in the GRECO study, are warranted in order to delay or prevent hypertension.

Limitations

The limitations of this work are mostly due to its cross-sectional nature; although a special effort was given during designing the study, implementing and analyzing the results in order to avoid potential confounding. Overweight and obese children may have under-reported food intake leading to information bias. This was addressed by testing the repeatability of the information regarding sodium intake in a sub-sample of schoolchildren of same age and sex. Additionally, it was mentioned that table salt and salt added while cooking was not evaluated on the effect of dietary sodium intake. This would not have been practical since it is difficult to measure it when using a FFQ. Finally, the use of international instead of local food composition tables (due to the incompleteness) may have over-estimated or under-estimated the sodium intake of some foods studied.

In conclusion, high sodium intake from 'hidden' sources was observed in Greek childhood population, with greater intakes found in children closer to the Mediterranean diet. Thus, the childhood population in Greece should be targeted for a sodium reduction program and not only for the ongoing epidemic of obesity. Moreover, the consumption of a dietary pattern close to the Mediterranean seems not to be a panacea for children's health, since greater adherence was associated with higher sodium intake through 'hidden' sources. The later finding does not moderate the undoubtable health benefits gained from this traditional dietary pattern, but should stress manufacturers to reduce the amount of sodium added during processing of 'healthy' foods. This information gathered is valuable for health planners that are aware of the consequences of high sodium intake. Planning population preventive services is essential. Starting at childhood in order to decrease incidence of health issues linked to excess sodium intake seems to be very important.

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PAPER VII

Farajian P, Panagiotakos DB, Risvas G, Micha R, Zampelas A. A dietary pattern characterized by high cheese and red processed meat consumption is associated with higher blood pressure in children. 2014 (Submitted manuscript in the *Am J Clin Nutr*)

TITLE PAGE

Title: A dietary pattern characterized by high cheese and red processed meat consumption is associated with higher blood pressure in children

Short Title: Dietary patterns and blood pressure in children

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Abstract

Background: Dietary habits have been associated with the likelihood of high blood pressure (BP) levels in children.

Objective: The objective of the present study was to investigate possible associations of dietary patterns with high blood pressure in a nationwide cross-sectional sample of 10-12 years old Greek schoolchildren.

Design: Anthropometric measurements and information on dietary (by a semi-quantitative food frequency questionnaire) and physical activity habits were obtained from the children. Blood pressures was measured in a single occasion using a standard protocol. Data from 2024 normal energy reporting children were included in the analysis. Principal component analysis was applied to identify lifestyle patterns.

Results: Seven dietary components (patterns) were extracted explaining 55% of the total variation in intake. Multiple logistic regression analysis revealed that predictors of high blood pressure (75th percentile of systolic and/or diastolic BP) were a pattern mainly characterized by the high consumption of cheese and red processed meat [Odds Ratio (OR) 1.15; 95% Confidence Intervals (CI) 1.03, 1.30], being overweight (OR 2.10; 95% CI 1.61, 2.73) or obese (OR 3.84; 95% CI 2.44, 6.06), and breakfast frequency (OR 0.95; 95% CI 0.90, 0.99). After controlling for sodium intake levels the dietary pattern did not remain significant predictor of high blood pressure, indicating the potential mediating effect of sodium in the association.

Conclusions: A dietary pattern that is characterized by high cheese and red processed meat consumption increases the likelihood of having high BP in children, probably through increasing

dietary sodium intake. These findings could guide future interventions or public health initiatives to prevent the increasing rates of childhood elevated blood pressure levels.

Keywords: cheese, red meat, dietary patterns, principal component analysis, children, blood pressure

Introduction

It is now established, that high blood pressure (BP) is detectable in children and adolescents, and is increasing in prevalence (1-3). The increase in blood pressures in children during the past decade may be attributable, at least in part, to the parallel increased prevalence of overweight and obesity (2, 4, 5). Despite the variations in age, sample size, and definition across the different studies, the reported prevalence of high BP among children and adolescents describes an important health issue, since it has been demonstrated that childhood hypertension tracks into adulthood (6). However, the negative consequences of high BP are not only limited to adulthood (7,8), but also during the early ages (9).

According to the most recent recommendations for the management of high BP in children and adolescents (10-12), therapeutic lifestyle changes are recommended as an initial treatment strategy for children or adolescents with high BP. These lifestyle modifications include regular physical activity, avoiding excess weight gain, limiting dietary sodium intake, and increasing the consumption of fresh fruits, vegetables, fiber, and low-fat dairy products. The importance of sodium intake in determining the blood pressure levels in children and adolescents is shown in many observational studies (13, 14). However, as it has been shown by the Dietary Approaches to Stop Hypertension (DASH) trial (15), the most substantial reductions in BP levels have been achieved through dietary modifications that promote changes in the intake of several foods and as a consequence nutrients. A DASH type diet, which is rich in fruits, vegetables, low-fat dairy, fish and low in sodium, has been shown to lower and normalize BP levels in pre-hypertensive and hypertensive adolescents (16), and therefore is currently recommended for prevention and treatment of elevated BP in children. Nevertheless, the number of studies investigating the potential effect of certain foods or food groups in children's BP levels are limited, and mostly focused on the role of dairy products and the DASH-type eating pattern (17-20), while to the best of our knowledge, no previous study has examined holistically the possible association of specific dietary patterns with children's BP levels.

Since people's diet choices include a variety of foods and nutritional habits that may act interactively on the risk of developing a disease, during the last years, several investigators have suggested using a holistic dietary approach on disease prevention, giving much attention in pattern analysis (21,22). Instead of looking at individual nutrients or foods, pattern analysis examines the effects of overall diet and represents a broader picture of food and nutrient consumption and possibly explain nutrient-disease relations (23). Specifically, principal components analysis (PCA) evaluates the correlations between all food intake variables and reveals similarities in the habits of people.

Consequently, following the holistic dietary assessment approach, the aim of this cross-sectional study was to investigate whether the extracted dietary patterns of children were associated with high BP levels, after controlling for several lifestyle and dietary habits.

Subjects and methods

Study sample

Under the context of the GRECO study, during 2009 a representative number of randomly selected public primary schools (fifth and sixth grade primary schoolchildren, 10-12 years old) were invited to participate to the study, according to a stratified sampling procedure by gender and age group, based on the population distribution in 10 regions of the country. Detailed information regarding subjects' collection has been reported elsewhere (24). For the purposes of the present study in order to obtain more valid dietary data we identified under-reporting and over-reporting children and excluded them from further analysis. Thus, after checking the completeness of the provided data, the working sample included 2024 children (mean age 10.9±0.7, 52% girls and 48% boys). Signed parental consent forms were obtained for all participating children. This study was conducted according to the guidelines laid down in the Declaration of Helsinki. The research tools and all the means used in the study were approved by the Hellenic Ministry of Education (Department of Primary Education), and the Agricultural University of Athens research committee.

Dietary and eating behavior assessment

Dietary assessment was based on a validated self-reported, semi-quantitative picture-aid food frequency questionnaire (FFQ), consisted of 48 food items commonly used in the local Greek cuisine (25,26). All participants were asked about their usual frequency of consumption of the food items with the following response categories: Everyday, 3–6 times/week, 2 times/week, 1 time/week, 1–2 times/month and seldom/never. The questionnaire included supplementary questions assessing the frequency of breakfast consumption and eating occasions (number of meals and snacks during the day), as well as the frequency of having meals in front of a screen (watching television/DVD/videos and/or using of games consoles/computer), and the frequency of having meals together with the whole family or at least with one family member with the following response categories: Everyday, 5–6 times/week, 3-4 times/week, 1-2 times/week, and seldom/never. Specifics on the type of food consumed were also asked (such as whole wheat bread vs. white bread, brown rice vs. white, whole wheat pasta vs. white, etc.). To estimate the daily energy and sodium intake coming from foods (excluding table salt and salt added during cooking), the United States Department of Agriculture food composition tables (27) and local food composition tables (28) were used. The evaluation of repeatability of dietary information regarding sodium intake were tested in a sample of 21 girls and 23 boys (aged 10-12 years) from 1 school unit in Athens, applying the semi-quantitative FFQ two times (within a 30 day interval) in the same children. Results showed very good repeatability between the two measurements (Spearman's rho=0.82, p<0.001, % of agreement using Bland-Altman graphical method=93.2%). Furthermore relative validity of such information was assessed using 3-day recalls which applied 30 days after the FFQ in a second sample of 20 girls and 13 boys (aged 10-12 years) from the same school unit. Very good relative validity was revealed regarding sodium consumption resulting from FFQ and 3-day recalls (Spearman's rho=0.57, p<0.001, % of agreement using Bland-Altman graphical method=91.0%).

Estimation of energy misreporting

Energy misreporting (i.e., under- and over- reporting) was estimated using the Goldberg equation (29) according to the ratio of energy intake (EI) to basal metabolic rate (BMR). In particular, age-specific Schofield's equations were used to estimate BMR from measured weight

(30), while physical activity level (PAL) was set on 1.55 indicating moderate activity according to mean values of PAQ score. The evaluation of individual intake considering long records was based on 28 days as the FFQ used in the present study referred to usual food intake of the past. The within subject daily variation in EI (CV_{wE}) was set at 23% as suitable average value (31), the variation in BMR (CV_{wB}) was set at 8.5% and the between subject variation in physical activity (CV_{tP}) was set at 15% as suitable averages (29). According to these, under-reporters of EI were defined as those with EI:BMR<1.09, while over-reporters of EI were those with EI:BMR>2.21.

Anthropometric measurements

Body weight (kg) was measured to the nearest 100 g with the use of a digital scale (Tanita TBF 300). Standing height was measured using a portable stadiometer (Leicester height measure) to the nearest 0.1 cm without shoes. Body mass index (BMI) was calculated by dividing weight (kg) by standing height squared (m^2). Obesity and overweight among children were calculated using the International Obesity Task Force (IOTF) age and gender specific body mass index cut-off criteria (32). Waist and hip circumferences were measured to the nearest 0.1 cm with the use of a non-elastic tape (Seca, Germany) and with the subject at a standing position. Waist circumference was measured at the end of a gentle expiration after placing the measuring tape in a horizontal plane around the trunk, at the midway between the lower rib margin and the iliac crest. Hip circumference was measured at the point yielding the maximum circumference over the buttocks. Waist to hip (W/Hp) and waist to height (W/Ht) ratios were also calculated. The measurements were conducted by investigators and staff of the Unit of Human Nutrition of the Agricultural University of Athens. All investigators followed a series of planning meetings and were trained in survey methods that included practical experience in measuring techniques. All study sites used the same measuring equipment and procedures and in each class the investigators' team consisted of at least two people. All measurements were performed during morning hours.

Physical activity and sedentary behaviors assessment

All participants were asked to complete the Physical Activity Questionnaire for Older Children (PAQ-C) (score 1-5) (33). Children were also asked to report the average weekdays and weekend' s time (h/d) spent on sedentary activities and more specifically on watching television/DVD/movies and/or recreational usage of games consoles/computer, defined as screen time. By combining the former two responses, mean daily hours of watching television/DVD/movies and/or recreational usage of games consoles/computer was calculated.

Blood pressure measurements and classification of children

Blood pressure (BP) was measured in a single occasion within the schools' settings using validated oscillometric devices (UA-787 oscillometric blood pressure monitor, A&D Company) (34), equipped with the right type of cuff for children of this age so that the length of the bladder in the cuff should cover 80%-100% of the individual's arm circumference. During the measurements children were calm, in a sitting position with their back supported, with the right arm resting on a solid supporting surface at heart level, and at least 10 minutes at rest. Two subsequent measurements were taken with a 5 minutes interval in order to familiarize children with the procedure, and the diastolic and systolic BP values of the second measurements were recorded. In the absence of established criteria for children, participants were classified as having high BP when systolic BP (SBP) and/or diastolic BP (DBP) were greater than or equal to the upper quartile of the distribution of the studied population (i.e. 75th percentile) adjusted for gender and height percentiles (i.e 5th, 10th, 25th, 50th, 75th, 90th, 95th). Specifically, the SBP and DBP height adjusted thresholds for girls were set at 106, 109, 113, 114, 118, 119, 123, 123 (all values are in mmHg) and 73, 74, 75, 75, 79, 78, 80, and 82 mmHg, respectively. In the case of boys the SBP and DBP thresholds were set at 111, 110, 112, 116, 117, 121, 121, 125 mmHg, and 76, 75, 74, 78, 77, 79, 81, 80 mmHg, respectively.

Statistical analysis

Continuous variables that were normally distributed are presented as mean ± SD (standard deviation). Normality was evaluated using the P-P plots. Skewed variables are presented as medians and quartiles and categorical variables as frequencies. Associations between categorical variables were tested by the calculation of chi-squared test. Student's t-test for independent samples was used to evaluate mean differences between normally distributed variables, where in case of skewed continuous variables, the tested hypothesis was evaluated using the non-parametric U-test suggested by Mann and Whitney.

To obtain food patterns the factor analysis with the principal components method (PCA) was applied to the food variables (35). From the entire database of the 48 food variables, 19 foods, food groups and beverages were finally used in the analysis based on their nutrients composition and the previous relevant studies in the literature (Table 3). The food variables used had continuous distributions representing servings per day of the food item, food group or beverage, consumed. The correlation matrix of the food variables used showed that there were several correlation coefficients with absolute value >0.3. The Kaiser–Meyer–Olkin (KMO) criterion and Bartlett's test of sphericity were also used to assess the suitability of the data for PCA. An overall KMO criterion close to unity suggests very good inter-correlation of variables and that the data set is suitable for PCA. Moreover, based on the criterion proposed by Kaiser, i.e., the number of components that should be retained is equal to the number of eigenvalues that are greater than one, since these components explain more information than the individual food variables; it was concluded that the first seven components should be extracted. Based on the principle that the component scores (loadings) are interpreted similarly to correlation coefficients, thus, higher absolute values indicate that the food-variable contributes most to the construction of the component, the food–components (patterns) were named according to scores of the foods or food groups that were > 0.4.

Multiple logistic regression analysis was then applied to evaluate the association of each of the dietary patterns derived in relation to the likelihood of having high blood pressure. Results are presented as odds ratios (OR) and their corresponding 95% confidence intervals (95%CI). Furthermore, multiple linear regression analyses were applied to evaluate associations between SBP and DBP and dietary patterns derived from the PCA, after adjustment for several potential confounders and testing for collinearity using their first product moments. All reported p-values were based on two-sided tests. Statistical calculations were carried out using SPSS 18 software (SPSS Inc., Chicago, IL, USA).

Results

Among participants, 37.6% were categorized as having high blood pressure levels (≥75th percentile of systolic and/or diastolic BP levels). Anthropometric and lifestyle characteristics of the participating children according to their BP levels classification are presented in ***Table 1***. Children with high BP had higher mean values in all anthropometric characteristics (i.e., weight, waist and hip circumference, waist-to-height and waist-to-hip ratio) compared to children with low BP, and a significantly larger proportion was classified as overweight or obese. In ***Table 2*** the energy, dietary sodium (excluding table salt and salt added during cooking), and dietary habits distribution of the participants, by blood pressure status are presented. Using the recommended European cut-off it was observed that a higher proportion of children with high BP had high sodium intake (>2200 mg/day) ($P<0.001$, $X^2=13.5$) and consumed breakfast less regularly than their normotensive peers. Concerning single food and food groups intake, the comparison of children in the two different BP level categories showed that children with normal BP levels had lower intakes of red meat servings/day [0.29 (0.10 ; 0.43)] vs. [0.29 (0.10 ; 0.57)] (P=0.019), respectively, and total cheese [1.34 (0.72; 2.20)] vs. [1.53 (0.81; 2.66)] (P=0.001), respectively, than children with high BP.

Table 1: Demographic, anthropometric and lifestyle characteristics of the children presented by blood pressure status*.

	Low blood pressure N=1262	High blood pressure N=762	P‡
Gender (%)			0.87
Males	62.9	37.1	
Females	62.5	37.5	
Age, (years)	10.9 (0.7)	10.8 (0.7)	0.051
Weight (kg)	42.8 (9.4)	46.9 (10.7)	<0.0001
Height (cm)	149.0 (7.6)	149.1 (8.0)	0.85
Body Mass Index (kg/m^2)	19.2 (3.3)	20.9 (3.7)	<0.0001
Waist circumference (cm)	66.6 (8.5)	69.6 (10.1)	<0.0001
Hip circumference (cm)	80.8 (9.3)	83.8 (10.3)	<0.0001
Waist-to-Height ratio (cm)	0.45 (0.06)	0.47 (0.06)	<0.0001
Waist-to-Hip ratio (cm)	0.82 (0.07)	0.83 (0.09)	0.029
BMI status (%)			<0.0001
Normal weight	70.4	29.6	
Overweight	52.5	47.5	
Obese	40.1	59.9	
IPAQ score (0-5)	2.93 (0.61)	2.96 (0.59)	0.27

TV watching and video game playing in weekends (hours)	2.86 (2.10)	2.93 (2.10)	0.50
TV watching and video game playing in weekdays (hours)	1.93 (1.34)	1.99 (1.39)	0.32

The reported *p*-values were calculated using the t-test, the chi-square test

* High blood pressure (BP) was defined as systolic BP and/or diastolic BP greater than or equal to the upper quartile of the distribution of the studied population (i.e. 75th percentile) adjusted for gender and height percentiles.

Table 2. Energy, sodium and dietary habits distribution of the participants, by blood pressure status*.

	Low blood pressure N=1262	High blood pressure N=762	P‡
Energy intake (kcals/day)	2002.8 (1699.9, 2382.2)	2080.6 (1738.8, 2505.5)	0.001
Na (mg/day)	1753.2 (1419.7, 2214.4)	1854.5 (1488.3, 2355.7)	0.002
High sodium intake (Na>2200 mg/day) (%)	25.3	33.4	<0.001
Having breakfast (times/week)	4.72 (2.39)	4.38 (2.47)	0.003
Number of meals and snacks during the day	3.10 (1.22)	3.17 (1.25)	0.204

Frequency of meals outside home (plus ordering out) (%)			0.459
Two or more times / week	10.1	10.6	
Less than 2 times / week	89.9	89.4	
Frequency of family meals (%)			0.50
Less than 5 times/week	43.0	41.4	
5 or more times/week	57.0	58.6	
Frequency of meals in front of the TV, (%)			0.26
Less than 3 times/week	79.7	82	
3 or more times/week	20.3	18.0	

The reported *p*-values were calculated using the t-test, the chi-square test or the Mann-Whitney U test.

* High blood pressure (BP) was defined as systolic BP and/or diastolic BP greater than or equal to the upper quartile of the distribution of the studied population (i.e. 75th percentile) adjusted for gender and height percentiles.

Based on factor analysis, seven components that explained the 55% of the total variation in consumption were extracted and studied here. The value of the KMO criterion was equal to 0.6 and the P value for Bartlett's test of sphericity was <0.001, indicating that the lifestyle variables entered in the analysis were strongly intercorrelated and, therefore, factor analysis could be used for assessing meaningful dietary patterns. The loadings for the seven food components (patterns) that represent the correlation of each food item with the corresponding component, are presented in ***Table 3*** (in bold are the coefficients with absolute loadings > 0.4;

which means that are better correlated with the component). Since the higher absolute values indicate that the food variable contributes more to the characterization of the component (Mardia et al, 1979), it could be suggested that the extracted components are characterized as follows: higher consumption of vegetables, legumes and olive oil and lower consumption of sweets (component 1); higher consumption of starch and cereals and whole grain products (component 2); higher consumption of meat (red and white) and lower consumption of fruits and whole grain products (component 3); higher consumption of liquid calories and lower in starch/cereals and whole grain products (component 4); high consumption of cheese and red processed meat (component 5); low consumption of nuts and fish (component 6); higher consumption of nuts and lower consumption of meat (red and white) (component 7). Component 1 was the most dominant food pattern and explained 12.8% of the total variance. Each of the remaining components explained from 9.2% to 5.6% of variance in intake.

Two nested multiple logistic regression models were estimated in order to evaluate the association between the extracted dietary patterns and the likelihood of having high BP levels (**Table 4**). The addition of dietary sodium intake (as a binary variable, i.e. intake above or below 2200 mg/day) in the second model assisted in exploring the potential mediating effect of sodium intake in the association of the parameters examined with the risk of having high BP. Variables included into the model of multinomial logistic regression analysis were selected according to the results of unadjusted models (i.e., $p<0.05$) and as such to avoid collinearity. The BMI, as an indicator of body adiposity, was preferred to enter in the model because it was stronger associated with the SBP and DBP of children than WC, WHpR and WHtR. The first model revealed the food pattern that is mainly characterized by the consumption of cheese and red processed meat was associated with 15% higher likelihood of having high blood pressure

($p<0.05$). In addition, both overweight and obese children had 2.1 and 3.84 higher odds of having high BP (both p's <0.001). Finally, increasing breakfast consumption frequency by 1 time per week, was associated with a 5% lower likelihood of having high blood pressure ($p<0.05$). In the second model after the adjustment for dietary sodium intake levels, the food pattern characterized by the high consumption of cheese and red processed meat, was not associated with high BP, indicating that the potential aggravating effect of this dietary pattern in blood pressure levels is mediated through the increased intake of sodium. Nevertheless, BMI status (both p's <0.001) and breakfast intake ($p<0.05$) still remained significantly associated with the likelihood of having high blood pressure.

Furthermore, linear regression analyses, between SBP and DBP and the extracted dietary patterns, after controlling for the same confounders as above, i.e., gender, age, breakfast frequency, and BMI, confirmed the positive association of the food pattern that was characterized by the consumption of cheese and red processed meat with the SBP of the children (standardized B=0.07, p=0.013), but not with the DBP. After controlling for sodium intake levels, this association did not remain significant. However, BMI (B=0.27, $p<0.001$; B=0.26, $p<0.001$, respectively) and sodium intake level (B=0.07, $p<0.05$; B=0.08, $p<0.05$, respectively), were both associated with SBP and DBP, respectively, but not breakfast consumption frequency (B=-0.02, p=0.43; B=-0.03, p=0.27, respectively).

Table 3. Score coefficients (loadings) derived from factor (principal components) analysis regarding foods or food groups consumed by the participants.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Vegetables	**0.80**	0.19	0.07	-0.01	-0.13	0.36	0.20
Legumes	**0.40**	0.02	0.14	-0.27	-0.10	0.09	0.13
Nuts	-0.04	0.26	0.03	-0.01	-0.02	**-0.42**	**0.55**
Fish	0.34	0.20	0.18	0.23	-0.09	**-0.52**	0.02
Red meat	0.07	0.22	**0.53**	0.11	0.25	0.06	**-0.42**
Red processed meat	-0.18	0.26	0.12	0.22	**0.48**	0.27	0.25
Poultry	0.10	0.25	**0.44**	0.10	0.23	-0.29	**-0.41**
Total cheese [a]	0.04	-0.03	-0.15	0.06	**0.66**	0.09	0.12
Egg	0.12	0.18	-0.04	0.23	0.13	-0.21	0.32
Sweets [b]	**-0.48**	0.15	0.17	0.18	-0.10	0.27	0.13
Olive oil	**0.85**	0.29	0.24	-0.02	-0.08	0.25	0.06
Natural fruit juice [c]	0.16	0.24	**-0.41**	**0.48**	-0.14	0.01	-0.19
Fruits [d]	0.19	0.16	**-0.40**	0.25	-0.32	-0.11	-0.17
Sugared drinks [e]	-0.19	0.14	-0.19	**0.43**	-0.14	0.34	-0.12
Starch and cereals [f]	-0.31	**0.73**	-0.11	**-0.41**	-0.05	0.02	-0.08
Whole grain	-0.05	**0.58**	**-0.45**	**-0.47**	0.14	0.04	-0.13
French fries	-0.36	**0.40**	0.34	0.02	-0.33	-0.06	0.04

Chips/crisps	-0.39	0.22	0.32	0.26	-0.21	0.17	0.23
Milk and yogurt [g]	0.15	0.28	-0.31	0.33	0.30	-0.11	0.01

[a] Consumption of all types of cheese and cheese in mixed foods (e.g. pizza, pies)

[b] Consumption of chocolate, chocolate bars, and pastries

[c] Consumption of homemade and market 100% natural fruit juice

[d] Consumption of fruits excluding fruit juice

[e] Consumption of soft drinks and sugared fruit juices

[f] Consumption of breads, cereals, pasta and rice

[g] Consumption of milk and yogurt and dairy desserts

Table 4. Results from multiple logistic regression models that were applied to evaluate the association between food-components and the likelihood of having high blood pressure. Results are presented as odds ratios and 95%CI.

	Model 1	Model 2
Gender		
Females	1	1
Males	0.85 (0.67, 1.09)	0.82 (0.64, 1.05)
Food patterns (per 1 unit increase on components' scores)		
Component 1	0.99 (0.88, 1.11)	1.02 (0.90, 1.15)
Component 2	0.97 (0.86, 1.10)	0.92 (0.80, 1.05)

	Component 3	1.0 (0.89, 1,12)	1.00 (0.89, 1.12)
	Component 4	1.08 (0.96, 1.22)	1.07 (0.95, 1.21)
	Component 5	1.15 (1.03, 1.30)	1.08 (0.95, 1.23)
	Component 6	1.0 (0.89, 1.13)	0.98 (0.87, 1.10)
	Component 7	1.07 (0.95, 1.20)	1.04 (0.92, 1.17)
Age		0.93 (0.79, 1.09)	0.92 (0.78, 1.08)
BMI status			
	Normal weight	1	1
	Overweight	2.10 (1.61, 2.73)	2.08 (1.59, 2.70)
	Obese	3.84 (2.44, 6.06)	3.62 (2.29, 5.73)
Breakfast frequency		0.95 (0.90, 0.99)	0.95 (0.90, 0.99)
Sodium intake		-	
	Sodium intake below 2200 mg/day	-	1
	Sodium intake above 2200 mg/day	-	1.48 (1.07, 2.05)

All odds ratios and their corresponding 95% confidence intervals were calculated by performing multiple logistic regressions.

Discussion

The association between BP levels was tested in relation to dietary patterns of children aged 10-12 years old. Factor analysis revealed that the pattern mainly characterized by the high consumption of cheese and red processed meat, was associated with higher likelihood of having high BP levels, while when we performed linear regression analyses it was positively associated with SBP, after controlling for BMI, age, gender, and breakfast frequency. However, after controlling for dietary sodium intake this association did not remain significant, indicating the potential mediating effect of sodium. The positive association between sodium intake and BP levels in children is well established. In the meta-analysis of He and MacGregor (13) of 10 salt reduction trials with 966 participants for an average duration of 4 weeks, it was demonstrated that a modest reduction in salt intake had a significant effect on BP in children and adolescents. A 42% reduction in salt intake reduced systolic BP by 1.2 mmHg and diastolic by 1.3 mm Hg. In our previous work, under the context of the GRECO study, it was shown that 23% of the total sample had high sodium intake (>2200 mg/day), without taking into account added salt at the table or while cooking. The major sodium sources were pizza, hamburgers, fried potatoes, souvlaki (traditional meat product), white and yellow cheese, processed cereals and bread (36).

Studies investigating the effects of dairy products intake (independently or not to fruits and vegetables intake) have generally shown a protective effect on BP. Moore et al. (18) using a sample of children from the Framingham prospective study, found that children who consumed four or more servings of fruit and vegetables per day plus two or more servings of dairy products had smaller yearly gains in systolic and diastolic BP throughout childhood. Those with higher intakes of fruits and vegetables alone or dairy alone had intermediate levels of adolescent systolic blood pressure. Furthermore, in a recently published follow-up study it was shown that the combined intakes of ≥2 servings of dairy products and ≥3 servings of fruits and vegetables per day throughout adolescence led to about a 35% lower risk of elevated BP by late adolescence (17). Additionally, in the study of Yuan et al. (20) high dairy products intake (≥2 servings of dairy products including cheese) was independently associated with lower SBP levels.

Concerning the effects of red meat and processed red meat on BP levels, available studies investigating possible association are relatively scarce and limited to adult populations. It could be hypothesized that since the DASH diet which has been shown to lower BP levels, is low in saturated fat and red meat, the recommendation to limit red meat (and red meat products) intake could prove to be beneficial in lowering BP levels. Steffen et al. (37) evaluated the associations of dietary intake with the 15-y incidence of elevated blood pressure, and found that consumption of plant foods (especially whole grains, fruit, and nuts) was inversely associated and the consumption of red and processed meat was positively associated with 15-y cumulative incidence of elevated BP in men and women. Similarly, in a prospective cohort study of men (7 year follow up) it was found that red meat and poultry intakes were related directly to a greater SBP/DBP increase (38).

It is noteworthy that in all the previously mentioned studies, cheese intake in relation to BP levels was not assessed separately, but was grouped in the total dairy products intake. We chose to investigate cheese intake separately from the rest dairy products because our previous results showed that it is a major source of sodium in the Greek childhood population (36). The advantage of the PCA that we used in the present study is that it examines the effects of overall diet and represents a broader picture of food and nutrient consumption. Furthermore, it reveals similarities and captures the extremes in food intake and derives a number of independent linear combinations of a set of foods or food groups (the components) that retain as much of the initial dietary information. Thus, PCA evaluates the inter-correlations between food variables and reveals similarities in the habits of people. One of these similarities of our population of Greek children was the high consumption of cheese and red processed meat that was associated with higher likelihood of having high BP levels.

Another methodology for assessing dietary patterns in nutrition epidemiology studies is based on *a-priori* defined "healthy" dietary patterns, and assesses the level of adherence to nutritional schemes like the Mediterranean diet (MD), DASH diet, or other recommendations illustrated in food-pyramids. Concerning the association between the adherence to the MD and BP levels in children, in the study of Lazarou et al. (39) the relationship between diet quality, as assessed by the Foods E-KINDEX, and BP levels was assessed. The index included 13 components that assess consumption frequency of 11 major food groups or foods (ie, bread, cereals, and grains, fruit and fruit juices, vegetables, legumes, milk, fish and seafood, meat [excluding delicatessen and processed meat], salted and smoked meat food, sweets and snacks, and soft drinks), as well as two cooking techniques (fried and grilled foods). In a subsample of Cypriot children the Foods E-KINDEX score was found to be independently associated with lower BP among healthy children. Compared with children with a low diet score, those with at least an average foods E-KINDEX score were 57% less likely to have elevated systolic BP levels. As the authors pointed out, when the foods E-KINDEX was replaced by its individual components, no significant associations were observed between any of the individual foods and BP levels, suggesting that dietary patterns represent a stronger regulating factor of BP levels than individual foods and nutrients.

In the present work, it was revealed that both BMI status and sodium intake were independently associated with systolic and diastolic BP, verifying the results of previous studies (2, 5, 13, 40, 41). A novel observation was the protective effect of more regular breakfast consumption which was revealed in the logistic regression model, and remained significant even after controlling for BMI and dietary sodium intake. Breakfast skipping is one of the mostly referred habits associated with increased BMI in children and adolescents, and is also associated with lower overall diet quality and higher consumption of energy dense and high fat and sodium foods (42-44).

Limitations

The limitations of this work are mostly due to its cross-sectional nature. The effect size measures used (i.e., the odds ratios) tend to overestimate the actual effect of the cause on effect usually observed in prospective studies; and thus, the findings should be interpreted with caution. Furthermore, BP was measured in a single occasion within the schools' settings not giving us the opportunity to define pre-hypertension or hypertension, therefore, we evaluated low and high BP instead. Additionally, as it was mentioned table salt and salt added while cooking was not evaluated on the effect of dietary sodium intake. Finally, the use of international instead of local food composition tables (due to the incompleteness) may have over- or under- estimated the energy and sodium intake of some foods studied.

Conclusions

Dietary pattern analysis revealed behaviors in this childhood population that could not be assessed with any other traditional dietary assessment method. A dietary pattern mainly characterized by high consumption of cheese and red processed meat was positively associated with the likelihood of high BP levels independently of the BMI status of the children, probably through increasing dietary sodium intake. Since eating habits that may affect long-term BP levels are established in childhood, the need to improve dietary habits in children in order to treat or manage high BP becomes even more critical and deserves to be further investigated.

Authors contribution

AZ, DBP, PF, and GR were responsible for the study design and the supervision of the field study. DBP, PF, and RM were responsible for the statistical analysis. PF, DBP, GR, and AZ were responsible for the interpretation of the data. All authors carried out data collection or data management, contributed to database preparation and participated in writing the final version of the submitted manuscript. All authors read and approved the final manuscript.

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4.0 General conclusions

The results presented in the current PhD thesis, under the context of the GRECO (Greek Childhood Obesity) study in a nationwide representative sample of Greek schoolchildren aged 10-12 years old, reveal a very high overall prevalence of overweight (OW) and obesity (OB) that exceeds 40%. These results confirm the findings of other recent epidemiological studies in Greek childhood and adolescent populations showing approximately the same prevalence (Moschonis et al, 2013; Tzotzas et al, 2008; Tzotzas et al, 2011), and place Greek children among the most OW/OB in Europe, with rates exceeding even those reported in other Mediterranean countries facing the same problem (Binkin et al, 2010; Padez et al, 2004). We did not observe any differences in childhood OW and OB rates between large urban and semi-urban regions of the country, which confirms similar findings from previous studies in Greece (Georgiadis & Nassis, 2007), although there are other reports showing that children living in rural areas of the country have higher prevalence of OB (Tambalis et al, 2013). Regarding the adherence rates of children to the Mediterranean diet (MD), as assessed with the KIDMED index classification, only 4.3% of children had an optimal score, while 46.8% were classified as low adherers to the MD. Similarly, a previous study performed in Greek children and adolescents, demonstrated low adherence to the dietary patterns of the MD, since only 11.3% of children and 8.3% of adolescents had an optimal KIDMED score (Kontogianni et al, 2008). KIDMED score did not differ between boys and girls, but children from semi-urban areas of the country had higher KIDMED score as compared with those form large urban areas. Moreover, children with higher KIDMED score reported having higher physical activity levels (higher PAQ-C score). However, higher adherence to the MD was not associated with lower BMI levels, a result that comes in contrast with previous studies identifying a protective effect of the MD against the prevalence and development of childhood OW and OB, as well as central OB (Kontogianni et al, 2008; Lazarou et al, 2008a; Schröder et al, 2010; Tognon et al, 2013).

The etiology of childhood and adolescence obesity's nature has been characterized as complex and multifactorial involving both children's and parental characteristics and influences. Many different studies have identified several risk factors related with childhood OW/OB, which someone has to take into account when planning or implementing preventive actions. Therefore, in an attempt to identify those dietary and physical activity habits and behaviors, as well as parental perceptions and influences that are associated with the very high rates of childhood OW/OB, we aimed in our analysis to hierarchy the factors separately for children and parents. According to the logistic regression analysis we performed it was demonstrated that breakfast consumption, frequent eating occasions, and regular family meals were negatively associated with OW/OB and could therefore have a protective role in this age group. Although the physical activity levels (assessed with PAQ-C score) did not correlate with BMI levels, interestingly studying hours during weekdays (a sedentary behavior reported in the literature) (Wong & Leatherdale, 2009) was included in the lifestyle parameters that mostly affect the likelihood of OW/OB, as well as the presence of TV and PC/video game player in the children's bedroom (Cameron et al, 2013). Concerning the lack of association between physical activity levels and BMI, previous reports have also shown no association (Kontogianni et al. 2008; Tambalis et al, 2013). However, when we grouped children into 4 behavioral categories on the basis of their sedentary behavior and physical activity scores: 1) high active-low sedentary, 2) high active-high sedentary, 3) low active-low sedentary, and 4) low active-high sedentary, it was shown that boys who were classified as high active-low sedentary when compared with low active-high sedentary, had significantly lower BMI values. Nevertheless, this parameter did not remain significant in our fully adjusted regression model.

Regarding parental characteristics, children whose mothers were older in age had a reduced risk of being OW/OB, and both maternal and paternal BMI were significant predictors for childhood OW/OB status, an effect previously shown in Greek childhood populations (Kosti et al, 2008; Manios et al, 2010; Panagiotakos et al, 2008). Strikingly, the most dominant risk factor according to the results of the analysis was the parental misperception of the children's body weight status and the inability to recognise OW in their children. The likelihood of parents who misclassified their child's body weight status, to have an OW/OB child was 6.22 times greater. According to the parents' perspective on the body weight status of their child, only 25.4% of the parents reported believing that their child had increased BMI, while the actual measured percentage of children categorized as OW/OB was over 40%. Additionally, in the case of OW/OB children, 47.9% of their parents reported believing that their children was normal weight (47.1%) or even under-weight (0.8%).

Furthermore, in an attempt to specifically identify the possible socioeconomic and demographic factors associated with childhood OW/OB in our sample, we performed a separate analyses. Among several parameters indicating socioeconomic status (SES) that we evaluated in a multiple regression analysis, the most important SES predictors of childhood obesity were mother's age (for both genders) and father's type of occupation (only for girls). More specifically, increased mother's age and a less manual paternal type of occupation, a factor which is considered indicative of social class (Hart el al, 2008), seemed to have a protective effect on the likelihood of having an OW/OB child. Furthermore, the odds for a child of being OW/OB were threefold higher when both parents were OW/OB as compared with normal-weight parents (OR 3.24; 95% CI 2.39, 4.38). However, in the present sample analysis both family income and parental educational level did not seem to be related to the likelihood of children to be categorized as OW/OB, although other studies in Greek childhood populations have shown that low parental education (Birbilis et al, 2013; Kontogianni et al, 2010; Antonogeorgos et al, 2013) and lower family income (Moschonis et al, 2010) were associated with childhood OW and OB.

Another objective of this thesis was to explore the pre- and postnatal factors that were related to the prevalence of children's OW/ OB. The perinatal factors which were found to have a strong association with overweight/obesity were high maternal weight at conception and maternal heavy smoking (>20 cigarettes per day) at conception, even after adjustment for confounding factors. In addition, high maternal age at gestation was inversely associated with overweight and obesity. Research on maternal high pre-pregnancy weight (Whitaker RC, 2004; Kuhle et al, 2009) and smoking during pregnancy (Moschonis et al, 2008; Oken et al, 2008) in relation to subsequent risk of OW/OB appears to have consistent outcomes. In the case of smoking, available data suggest a dose-depended association between smoking during pregnancy and later risk of childhood OB. In the case of our results the relation between heavy smoking at conception and OW/OB in childhood could probably be explained by the aggravating lifestyle patterns of the parents, which could lead to the increased BMI of their child. Furthermore, according to the analysis, no association between breastfeeding (exclusive or total duration) and OW/OB prevalence was shown. This issue has been addressed in recent meta-analyses generally concluding that breastfeeding offers weak to moderate protection against obesity, although there are studies showing weak or no association (Weng et al, 2012).

An additional objective of this PhD thesis was to identify lifestyle and dietary patterns that are associated with elevated blood pressure levels and dietary sodium intake. Therefore, the daily dietary sodium intake (without taking into account table salt and salt added during cooking) of the population was studied, within the context of the Mediterranean diet pattern. High sodium consumption was considered an intake over 2200 mg/day and adherence to the Mediterranean dietary pattern was evaluated using KIDMED score. The results showed that 23% of the total sample had high sodium intake (>2200 mg/day), and the major sodium sources were pizza, hamburgers, fried potatoes, souvlaki (traditional meat product), white and yellow cheese, processed cereals and bread. Another important finding was that children closer to the Mediterranean diet (MD) reported a higher dietary sodium intake. A possible explanation of the high sodium intake of children with moderate and high MD adherence is that 34% of total sodium intake was found to be consumed by those foods known as "healthy" (i.e., bread, processed cereal and white cheese). These foods which are recommended to be consumed on a daily basis according to the MD scheme, are in fact the everyday hidden sources of sodium, due to sodium addition during manufacturing, and seem to add substantially to the total dietary sodium of an otherwise healthy dietary pattern (Brown et al, 2009; He and MacGregor, 2006). It should be noted, however, that although the MD adherence was shown to be accompanied by high intakes of sodium, still provided protection against high blood pressure (BP) levels probably through the high intakes of potassium mainly from the increased consumption of fruits and vegetables, since no differences were found in BP levels of children within the KIDMED score categories.

Finally, the association between BP levels was tested in relation to dietary patterns of the children, after identifying under- and over-reporting children and excluding them from further analysis. Factor analysis revealed a novel observation which has not been indicated before in the literature, that the pattern mainly characterized by the high consumption of cheese and red processed meat, was associated with higher likelihood of having high BP levels (i.e. (≥75th percentile of systolic and/or diastolic BP levels, adjusted for gender and height percentiles). In addition, both OW and OB children had 2.1 and 3.84 higher odds of having high BP, and increasing breakfast consumption frequency by 1 time per week, was associated with a 5% lower likelihood of having high blood pressure. After the adjustment for dietary sodium intake levels (as a binary variable, i.e. intake above or below 2200 mg/day), the food pattern characterized by the high consumption of cheese and red processed meat, was not associated with high BP, indicating that the potential aggravating effect of this dietary pattern in BP levels is mediated through the increased intake of sodium. Nevertheless, BMI status and breakfast intake still remained significantly associated with the likelihood of having high blood pressure. These results besides verifying the well established positive association of dietary sodium intake, as well as OW and OB, with the BP levels in children (He and MacGregor, 2006; Kotchen TA, 2010; Ostchega et al, 2009), revealed that a dietary pattern mainly characterized by high consumption of cheese and red processed meat was positively associated with the likelihood of high BP levels independently of the BMI status of the children, probably through increasing dietary sodium intake.

In summary, the results presented in the current PhD thesis, although come from a study with a cross-sectional design and as a consequence do not provide definitive conclusions on causality between different factors, provide a wide range of associations between several dietary, physical activity and behavioral factors and the high prevalence of OW and OB in the studied childhood population. In addition, lifestyle and dietary patterns that are associated with elevated blood pressure levels and dietary sodium intake were identified. Since lifestyle and eating habits that may affect health indices levels in the long term are established in childhood, the need to improve dietary habits and lifestyle parameters in children seems to be critical and deserve to be further investigated. Findings of the current thesis could guide future interventions or public health initiatives to prevent or even confront the increasing rates of childhood OW and OB and of elevated blood pressure levels.

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6.0 Future work

It is in our future intention to further analyze data provided from the GRECO study in the following research areas:

i. Investigation of possible associations between dietary patterns and overweight and obesity prevalence.
ii. Examination of the diagnostic ability of anthropometric indices (BMI, % body fat, waist circumference, waist to hip ratio, waist to height ratio) for the detection of high blood pressure in children.
iii. Identification of the main sugar and saturated fatty acids food sources and investigation of their association with childhood overweight and obesity prevalence.
iv. Investigation of the relationships between sleeping habits, dietary intakes, physical activity and childhood overweight and obesity.

APPENDIX 1 (Abstracts published in conference proceedings)

I. **Farajian P**, Karasouli K, Risvas G, Panagiotakos DB, Zampelas A. Repeatability and validity of a food frequency and dietary habits questionnaire in children. Circulation 2009;119:e288 (abstr).

Repeatability and Validity of a Food Frequency and Dietary Habits Questionnaire in Children

Aim: This work aimed to assess the relative validity and repeatability of a semi-quantitative food frequency questionnaire (FFQ) in children.

Methods: Dietary intakes and habits were assessed using the FFQ that contained all basic foods and food-groups, as well as beverages and a 3-d dietary record as the reference method. Eighty-two healthy children (47 girls and 35 boys), 11–12 years old, were recruited from public schools and asked to fulfill the FFQ and also to provide non-consecutive 3-d dietary records. The repeatability of the FFQ was assessed by repeated administration in the same children two weeks after the first completion. Data analysis was based on Wilcoxon non-parametric pairwise comparisons test and Spearman's correlation coefficient, after energy intake adjustment.

Results: There were no significant differences between the two examinations for most foods and food groups' frequency consumption, as well as between the reported dietary and everyday living habits known to affect obesity status. W-test values ranged between -1.77 to -0.13 (all P-values>0.1). Moreover, hours of TV viewing were associated with increased saturated fatty acid (SAFA), dietary cholesterol and sodium intake, while eating outside home was inversely associated with monounsaturated fatty acids and calcium intake. Breakfast skipping was associated with increased total fat and SAFA dietary intake, while children that reported having breakfast also had increased carbohydrates and vitamin C intake. Additionally, significant correlations were observed for some energy dense foods, such as burgers, pizza, salty snacks, ice cream, and fried potatoes and total energy intake. Spearman correlations between the aforementioned factors ranged from -0.45 to 0.55 (all P-values<0.05). No gender differences were observed in all analyses reported.

Conclusion: The applied questionnaire is a repeatable and valid tool to investigate the association between dietary habits, total energy intake and dietary nutrients.

II. Bountziouka V, **Farajian P**, Risvas G, Malisova O, Panagiotakos DB, Zampelas A. Development and validation of a semi-quantitative food frequency questionnaire for young school-aged children. Annals of Nutrition & Metabolism 63 (Suppl 1):1-1960, 2013 (abstr).

Development and validation of a semi-quantitative food frequency questionnaire for young school-aged children

Background and objectives: Accurate assessment of food intake in children and adolescents is an essential prerequisite for conducting epidemiological and clinical research on the links between diet and health. The objective of the present study was to examine the validity for estimating energy and macronutrients intake of a newly developed picture aid, semi-quantitative food frequency questionnaire (FFQ) for Greek children and preadolescents.

Methods: Sixty nine children, aged 10-12 years old (48% boys) were voluntarily enrolled in the study (86% participation rate). Children were asked to complete a 48 food items and 11 more supplementary questions, picture aid, FFQ as the test instrument and a 3-day Dietary Record (3DD) as the reference method. Anthropometric and lifestyle characteristics were also measured to evaluate the factors that may be related with reporting the dietary intake. The Bland and Altman method and the Wilcoxon signed rank test were used to evaluate the degree of agreement between the FFQ and the 3DD.

Results: The two methods were found to agree in terms of mean energy intake according to the Bland and Altman method, although a trend in overestimating energy intake was found as the intake increases. Additionally, results of the Wilcoxon signed rank test revealed the similarity of the distribution in energy intake as estimated from the FFQ and the 3DD (median (IQR): 2038 (1264 - 2651) kcals for the FFQ vs. 1902 (1583 - 2324) kcals for the 3DD, $p=0.33$). Concerning macronutrients intake, the agreement was also considered adequate as the mean difference for each nutrient was < 1SD of the same nutrient intake as estimated from the reference method.

Conclusions: The FFQ can be used to estimate mean daily energy intake in children, as well as to estimate macronutrients intake at the group level.

Key words: nutritional assessment; food frequency questionnaire; validation; children

III. **Π. Φαρατζιάν**, Δ. Παναγιωτάκος, Γ. Ρίσβας, Ρ. Μίχα, Α. Ζαμπέλας. Διατροφικοί παράγοντες και οικογενειακές συνήθειες που επηρεάζουν τα επίπεδα υπέρβαρου/παχυσαρκίας στα παιδιά: Η μελέτη GRECO**.** 6ο Εντατικό Σεμινάριο στην Εφηβική Ιατρική, 2013. (*Η εργασία τιμήθηκε με το 1ο βραβείο της Ελληνικής Εταιρίας Εφηβικής Ιατρικής "Γεώργιος Μαραγκός")*

Διατροφικοί παράγοντες και οικογενειακές συνήθειες που επηρεάζουν τα επίπεδα υπέρβαρου/παχυσαρκίας στα παιδιά: Η μελέτη GRECO

Εισαγωγή: Ο σκοπός της συγκεκριμένης μελέτης ήταν να εκτιμήσει τα επίπεδα και την αιτιολογία της παιδικής παχυσαρκίας στην Ελλάδα σε αντιπροσωπευτικό πανελλαδικό δείγμα μαθητών δημοτικού από αστικές, ημιαστικές και αγροτικές περιοχές, ηλικίας 10-12 ετών. Επιπρόσθετοι στόχοι ήταν η ταυτοποίηση των διατροφικών παραγόντων, των συνηθειών του τρόπου ζωής των παιδιών, αλλά και της οικογένειας που επηρεάζουν τον επιπολασμό της παιδικής παχυσαρκίας.

Μεθοδολογία: Η δειγματοληψία ήταν τυχαία και διαστρωματοποιημένη ανά γεωγραφική περιοχή. Εκτός από τις ανθρωπομετρικές μετρήσεις που πραγματοποιήθηκαν, τα παιδιά συμπλήρωσαν ένα ημι-ποσοτικοποιημένο ερωτηματολόγιο συχνότητας κατανάλωσης τροφίμων του οποίου η εγκυρότητα και επαναληψιμότητα είχε ελεγχθεί, αλλά και ειδικά σχεδιασμένα ερωτηματολόγια αξιολόγησης κοινωνικο-οικονομικών παραγόντων, διατροφικών συνηθειών και εκτίμησης της σωματικής δραστηριότητας. Η εκτίμηση της ενεργειακής πρόσληψης και των μακροθρεπτικών συστατικών έγινε σε υπό-δείγμα του συνολικού πληθυσμού, αποκλείοντας από την ανάλυση τα άτομα που υπο- ή υπερ-κατέγραφαν την ενεργειακή τους πρόσληψη, με βάση διεθνή όρια προσαρμοσμένα με το μέγεθος του δείγματος και τον αριθμό ημερών καταγραφής. Η εκτίμηση του επιπέδου σωματικής δραστηριότητας των παιδιών έγινε με το διεθνές ερωτηματολόγιο PAQ-C. Οι γονείς/κηδεμόνες των παιδιών εκτός από τη συγκατάθεσή τους για την πραγματοποίηση μετρήσεων στα παιδιά τους κλήθηκαν να συμπληρώσουν ένα ερωτηματολόγιο συλλογής των παρακάτω πληροφοριών: δημογραφικά και ανθρωπομετρικά στοιχεία, κοινωνικο-οικονομικά στοιχεία, αντιλήψεις των γονέων για τη διατροφή του παιδιού, δεδομένα για την αξιολόγηση της εφαρμογής της Μεσογειακής διατροφής.

Αποτελέσματα: Το συνολικό δείγμα από το οποίο συλλέχθηκαν πλήρη στοιχεία αποτελούνταν από 4786 παιδιά. Ο συνολικός αριθμός των γονέων που παρείχαν πλήρη στοιχεία ήταν 2315. Σύμφωνα με τα κριτήρια του IOTF στο συνολικό Πανελλαδικό δείγμα παιδιών το ποσοστό υπέρβαρου και παχυσαρκίας ήταν 29% και 11,2%, αντίστοιχα. Σχετικά με την αξιολόγηση της υπο- και υπερ-καταγραφής, το 36% κατατάχθηκαν ως υπό-καταγραφείς ενεργειακής πρόσληψης και το 16% ως υπέρ-καταγραφείς. Στα υπέρβαρα/παχύσαρκα παιδιά φάνηκε ότι η συμμετοχή του διαιτητικού λίπους και της πρωτεΐνης (%) στην συνολική ενεργειακή τους πρόσληψη ήταν υψηλότερη, αλλά χαμηλότερη η συμμετοχή των υδατανθράκων. Σε ότι αφορά τα επίπεδα σωματικής δραστηριότητας, δεν παρατηρήθηκαν διαφορές μεταξύ φυσιολογικών και υπέρβαρων ή παχύσαρκων παιδιών, ωστόσο τα υπέρβαρα/παχύσαρκα παιδιά είχαν σημαντικά μεγαλύτερο χρόνο τηλεθέασης και ενασχόλησης με τον Η/Υ, καθώς και περισσότερες ώρες μελέτης των μαθημάτων. Επιπρόσθετα η συχνότητα κατανάλωσης πρωινού γεύματος ήταν χαμηλότερη καθώς και τα συνολικά γεύματα και μικρογεύματα κατά τη διάρκεια της ημέρας ήταν λιγότερα στα υπέρβαρα/παχύσαρκα παιδιά. Επίσης η αυξημένη συχνότητα γευμάτων με άλλο ένα τουλάχιστον μέλος της οικογένειας φάνηκε ότι προστατεύει από τον κίνδυνο υπέρβαρου/παχυσαρκίας.

Συμπεράσματα: Τα αποτελέσματα της Πανελλαδικής μελέτης δείχνουν ότι το πρόβλημα της παιδικής παχυσαρκίας είναι ιδιαίτερα έντονο. Για να γίνει εφικτή η αλλαγή της διατροφικής συμπεριφοράς των παιδιών, πρέπει ο σχεδιασμός προγραμμάτων διατροφικής παρέμβασης να λάβει υπόψη τους κοινωνικο-οικονομικούς και οικογενειακούς παράγοντες που επηρεάζουν τον επιπολασμό της.

APPENDIX 2 (The questionnaires used in the GRECO study)

ΕΡΩΤΗΜΑΤΟΛΟΓΙΟ ΜΑΘΗΤΗ

ΚΩΔΙΚΟΣ:

ΗΜΕΡΟΜΗΝΙΑ ΣΥΜΠΛΗΡΩΣΗΣ ΕΡΩΤΗΜΑΤΟΛΟΓΙΟΥ: _ _/_ _/_ _ _ _

ΤΑΞΗ: ☐ Ε’ Δημοτικού ☐ ΣΤ’ Δημοτικού

ΣΧΟΛΕΙΟ:

Α. ΔΗΜΟΓΡΑΦΙΚΑ ΧΑΡΑΚΤΗΡΙΣΤΙΚΑ

ΦΥΛΟ 1. Αγόρι ☐ 0. Κορίτσι ☐

ΗΛΙΚΙΑ:

ΗΜΕΡΟΜΗΝΙΑ ΓΕΝΝΗΣΗΣ: _ _/_ _/_ _ _ _

Διεύθυνση κατοικίας:	**Νομός:**	**Πόλη:**	**Τ.Κ:**

Β. ΚΟΙΝΩΝΙΚΟ-ΟΙΚΟΝΟΜΙΚΑ ΧΑΡΑΚΤΗΡΙΣΤΙΚΑ

1. Ποια μέλη της οικογένειά σου μένουν μαζί σου στο σπίτι;

α. Μητέρα	1. ΝΑΙ ☐	0. ΟΧΙ ☐	
β. Πατέρας	1. ΝΑΙ ☐	0. ΟΧΙ ☐	
γ. Αδέρφια	1. ΝΑΙ ☐	0. ΟΧΙ ☐	Αν ΝΑΙ, πόσα; ....
δ. Παππούς	1. ΝΑΙ ☐	0. ΟΧΙ ☐	
ε. Γιαγιά	1. ΝΑΙ ☐	0. ΟΧΙ ☐	
στ. Άλλος (διευκρίνισε)	…………....		

2. Στο δωμάτιό σου κοιμάσαι μόνος σου; 1. ΝΑΙ ☐ 0. ΟΧΙ ☐

3. Έχεις στο δωμάτιό σου τηλεόραση; 1. ΝΑΙ ☐ 0. ΟΧΙ ☐

4. Έχεις στο δωμάτιο σου ηλεκτρονικό υπολογιστή; 1. ΝΑΙ ☐ 0. ΟΧΙ ☐

5. Πόσα αυτοκίνητα έχετε στην οικογένεια; ………..

Γ. ΧΑΡΑΚΤΗΡΙΣΤΙΚΑ ΤΡΟΠΟΥ ΖΩΗΣ

1α. Πόσες ώρες <u>μελετάς</u> τα μαθήματά σου τις <u>καθημερινές</u>;	………..	**1β. Πόσες ώρες <u>μελετάς</u> τα μαθήματά σου το <u>Σαββατοκύριακο</u>;**	……….
2α. Πόσες ώρες <u>βλέπεις τηλεόραση</u>/DVD, παίζεις ηλεκτρονικά παιχνίδια και σερφάρεις στο ίντερνετ τις <u>καθημερινές</u>;	……….	**2β. Πόσες ώρες <u>βλέπεις τηλεόραση</u>/DVD, παίζεις ηλεκτρονικά παιχνίδια και σερφάρεις στο ίντερνετ το <u>Σαββατοκύριακο</u>;**	…………
3α. Τι ώρα κοιμάσαι συνήθως το βράδυ τις <u>καθημερινές</u>;	………..	**3β. Τι ώρα κοιμάσαι συνήθως το βράδυ το <u>Σαββατοκύριακο</u>;**	…………..
4α. Τι ώρα ξυπνάς συνήθως το πρωί τις <u>καθημερινές</u>;	....	**4β. Τι ώρα ξυπνάς συνήθως το πρωί το <u>Σαββατοκύριακο</u>;**	…………
5. Κοιμάσαι συνήθως το μεσημέρι;	1. ΝΑΙ ☐ 0. ΟΧΙ ☐	**5.α. Εάν <u>ΝΑΙ</u> γράψε πόσες ώρες κοιμάσαι:**	…………
6. Έχεις δοκιμάσει ποτέ αλκοολούχο ποτό (μπύρα, κρασί, βότκα ουίσκι);	1. ΝΑΙ ☐ 0. ΟΧΙ ☐	**6.α. Εάν <u>ΝΑΙ</u>, δήλωσε πόσο συχνά πίνεις κάποιο ποτό;**	1. Σπάνια ☐ 2. Λίγες φορές το μήνα ☐ 3. 1 φορά/εβδομ. ☐ 4. 2 ή περισσότερες φορές / εβδομ. ☐
7. Έχεις δοκιμάσει ποτέ να καπνίσεις;	1. ΝΑΙ ☐ 0. ΟΧΙ ☐		
8α. Σημείωσε ποιο πιστεύεις οτι είναι το βάρος σου	………..	**8β. Σημείωσε ποιο πιστεύεις οτι είναι το ύψος σου**	…………...

9. Από το 1-5 σημείωσε πόσο ευχαριστημένος είσαι από το βάρος σου; (1=καθόλου, 5=πολύ)	○ 1	○ 2	○ 3	○ 4	○ 5

Δ. ΑΞΙΟΛΟΓΗΣΗ ΣΩΜΑΤΙΚΗΣ ΔΡΑΣΤΗΡΙΟΤΗΤΑΣ

1.Έχεις κάνει κάποια ή κάποιες από αυτές τις δραστηριότητες <u>την προηγούμενη εβδομάδα (7 ημέρες)</u>; Εάν ναι σημείωσε <u>πόσες φορές</u> (σημείωσε μόνο μια φορά σε κάθε σειρά).

	Όχι	**1-2**	**3-4**	**5-6**	**7 ή περισσότερες**
Κυνηγητό	☐	☐	☐	☐	☐
Έντονο περπάτημα	☐	☐	☐	☐	☐
Ποδήλατο	☐	☐	☐	☐	☐
Τρέξιμο ή τζόκινγκ	☐	☐	☐	☐	☐
Μάθημα αερόμπικ	☐	☐	☐	☐	☐
Κολύμβηση	☐	☐	☐	☐	☐
Χορό-Μπαλέτο	☐	☐	☐	☐	☐
Ποδόσφαιρο	☐	☐	☐	☐	☐
Μπάσκετ	☐	☐	☐	☐	☐
Σκέιτ	☐	☐	☐	☐	☐
Βόλεϊ	☐	☐	☐	☐	☐
Σκι	☐	☐	☐	☐	☐
Πολεμικές τέχνες	☐	☐	☐	☐	☐
Τένις	☐	☐	☐	☐	☐
Κάποιο άλλο άθλημα (Γράψε ποιο;)…………………….........	☐	☐	☐	☐	☐

2. Ποια από τις παρακάτω προτάσεις πιστεύεις οτι σε περιγράφει καλύτερα <u>για την περασμένη εβδομάδα;</u> Διάβασε και τις πέντε προτάσεις πριν επιλέξεις τη μια που σε περιγράφει καλύτερα.	1. Όλο μου τον ελεύθερο χρόνο τον πέρασα κάνοντας δραστηριότητες που χρειάζονταν λίγη σωματική προσπάθεια.	☐
	2. Μερικές φορές (1-2 φορές την περασμένη εβδομάδα) έκανα έντονες δραστηριότητες (κάποιο σπορ-άθλημα, έτρεξα, κολύμπησα, έκανα ποδήλατο, χορό) στον ελεύθερο μου χρόνο.	☐
	3. Συχνά (3-4 φορές την περασμένη εβδομάδα) έκανα έντονες δραστηριότητες (κάποιο σπορ-άθλημα, έτρεξα, κολύμπησα, έκανα ποδήλατο, χορό) στον ελεύθερο μου χρόνο.	☐
	4. Αρκετά συχνά (5-6 φορές την περασμένη εβδομάδα) έκανα έντονες δραστηριότητες (κάποιο σπορ-άθλημα, έτρεξα, κολύμπησα, έκανα ποδήλατο, χορό) στον ελεύθερο μου χρόνο.	☐
	5. Πολύ συχνά (7 ή περισσότερες φορές την περασμένη εβδομάδα) έκανα έντονες δραστηριότητες (κάποιο σπορ-άθλημα, έτρεξα, κολύμπησα, έκανα ποδήλατο, χορό) στον ελεύθερο μου χρόνο.	☐
3. <u>Την προηγούμενη εβδομάδα (7 ημέρες)</u> στο μάθημα της γυμναστικής πόσο συχνά ήσουν πολύ δραστήριος (έπαιζες έντονα, έτρεχες, πήδαγες); (Σημείωσε μόνο μία απάντηση)	1. Δεν συμμετέχω στο μάθημα της γυμναστικής...	☐
	2. Σχεδόν ποτέ..	☐
	3. Μερικές φορές...	☐
	4. Πολύ συχνά..	☐
	5. Πάντα..	☐

4. <u>Την προηγούμενη εβδομάδα (7 ημέρες)</u> τι έκανες συνήθως:

Α. Στα διαλείμματα; (Σημείωσε μόνο μία απάντηση)	1. Καθόμουνα (Διάβαζα, μιλούσα)..	☐
	2. Στεκόμουνα και τριγυρνούσα..	☐
	3. Έτρεχα και έπαιζα...	☐
	4. Έτρεχα και έπαιζα αρκετά..	☐
	5. έτρεχα και έπαιζα έντονα την περισσότερη ώρα..	☐
Β. Την ώρα του φαγητού (κολατσιού) (εκτός από το να τρως); (Σημείωσε μόνο μία απάντηση)	1. Καθόμουνα (Διάβαζα, μιλούσα)..	☐
	2. Στεκόμουνα και τριγυρνούσα..	☐
	3. Έτρεχα και έπαιζα...	☐
	4. Έτρεχα και έπαιζα αρκετά..	☐
	5. Έτρεχα και έπαιζα έντονα την περισσότερη ώρα..	☐

5.<u>Την προηγούμενη εβδομάδα (7 ημέρες)</u> πόσες φορές ακριβώς έπαιξες κάποιο άθλημα ή κάποιο παιχνίδι ή χόρεψες έντονα;

Α. Μετά το σχολείο (Σημείωσε μόνο μία απάντηση)	Καμία..	☐
	1 φορά την περασμένη εβδομάδα..	☐
	2 ή 3 φορές την περασμένη εβδομάδα..	☐
	4 φορές την περασμένη εβδομάδα..	☐
	5 φορές την περασμένη εβδομάδα..	☐
Β. Το απόγευμα (Σημείωσε μόνο μία απάντηση)	Κανένα...	☐
	1 φορά την περασμένη εβδομάδα..	☐
	2 ή 3 φορές την περασμένη εβδομάδα..	☐
	4 φορές την περασμένη εβδομάδα..	☐
	5 φορές την περασμένη εβδομάδα..	☐
6. <u>Το περασμένο Σαββατοκύριακο</u> πόσες φορές έπαιξες κάποιο άθλημα ή κάποιο παιχνίδι ή χόρεψες έντονα; (Σημείωσε μόνο μία απάντηση)	Καμία..	☐
	1 φορά το Σαββατοκύριακο...	☐
	2 ή 3 φορές το Σαββατοκύριακο	☐
	4 ή 5 φορές το Σαββατοκύριακο	☐
	6 ή περισσότερες το Σαββατοκύριακο..	☐

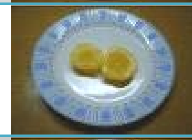
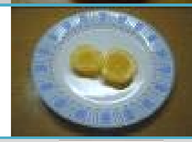
7. Ήσουνα άρρωστος την περασμένη εβδομάδα ή σε εμπόδισε κάτι άλλο από το να κάνεις τις φυσικές δραστηριότητες που κάνεις συνήθως; 1. ΝΑΙ ☐ 0. ΟΧΙ ☐

7.Α Εάν <u>ΝΑΙ</u>, γράψε μας τι σε εμπόδισε: ……………………………………………….........................

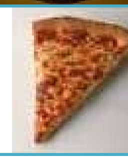
8. Πως πηγαίνεις στο σχολείο;	Α) Με το σχολικό	☐
	Β) Με το αυτοκίνητο του μπαμπά ή της μαμάς	☐
	Γ) Με τα πόδια	☐
	Εάν πηγαίνεις με τα πόδια, πόσα λεπτά κάνεις για να φτάσεις;	

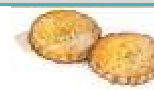
Ε. ΑΞΙΟΛΟΓΗΣΗ ΔΙΑΤΡΟΦΙΚΩΝ ΣΥΝΗΘΕΙΩΝ

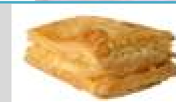
		Πόσο συχνά τρως τα εξής;						Πόσο σε μια μέρα;	
		Καμία	1 -2 φορές/ μήνα	1 φορά την εβδομάδα	2 φορές την εβδομάδα	3-6 φορές την εβδομάδα	Κάθε μέρα		
1	Δημητριακά πρωϊνού (κορν φλέικς σκέτα ή με σοκολάτα ή φρούτα)	○	○	○	○	○	○	Βλέπε εικόνα	
1α	Είναι τα δημητριακά πρωϊνού ολικής άλεσης;		1. ΝΑΙ ☐		0. ΟΧΙ ☐			2.ΜΕΡΙΚΕΣ ΦΟΡΕΣ ☐	
2	Μακαρόνια	○	○	○	○	○	○	Βλέπε εικόνα	
2α	Είναι τα μακαρόνια ολικής άλεσης;		1. ΝΑΙ ☐		0. ΟΧΙ ☐			2. ΜΕΡΙΚΕΣ ΦΟΡΕΣ ☐	
3	Ψωμί (συμπεριλαμβάνονται και τα τοστ)	○	○	○	○	○	○	Πόσες φέτες;	
3α	Είναι το ψωμί ολικής άλεσης;		1. ΝΑΙ ☐		0. ΟΧΙ ☐			2. ΜΕΡΙΚΕΣ ΦΟΡΕΣ ☐	
4	Όσπρια (φασόλια ή φακές ή ρεβύθια ή φάβα)	○	○	○	○	○	○	Βλέπε εικόνα	
5	Πατάτα (βραστή, ψητή ή πουρές)	○	○	○	○	○	○	Βλέπε εικόνα	
6	Ρύζι	○	○	○	○	○	○	Βλέπε εικόνα	
6α	Είναι το ρύζι λευκό ή καστανό;		1. ΛΕΥΚΟ ☐		2. ΚΑΣΤΑΝΟ ☐			3.ΑΝΑΜΙΚΤΟ ☐	
7	Φρυγανιές ή παξιμάδια ή κράκερ ή κριτσίνια ή σουσαμένιο κουλούρι	○	○	○	○	○	○	Πόσα τεμάχια;	

		Πόσο συχνά τρως τα εξής;						Πόσο σε μια μέρα;	
		Καμία	1 -2 φορές/ μήνα	1 φορά την εβδομάδα	2 φορές την εβδομάδα	3-6 φορές την εβδομάδα	Κάθε μέρα		
7α	Είναι οι φρυγανιές, τα παξιμάδια, τα κράκερ, τα κριτσίνια και το σουσαμένιο κουλούρι ολικής άλεσης;		1. ΝΑΙ ☐			0. ΟΧΙ ☐			
8	Μπανάνα	○	○	○	○	○	○	Πόσα τεμάχια; …………	
9	Μήλο ή αχλάδι ή πορτοκάλι ή μανταρίνια	○	○	○	○	○	○	Πόσα τεμάχια; …………	
10	Φράουλες ή κεράσια ή βερίκοκα	○	○	○	○	○	○	Βλέπε εικόνα …………	
11	Καρπούζι ή πεπόνι ή ροδάκινο ή σταφύλια	○	○	○	○	○	○	Βλέπε εικόνα …………….	
12	Αποξηραμένα φρούτα (Δαμάσκηνο ή βερίκοκο ή σύκο)	○	○	○	○	○	○	Βλέπε εικόνα …………	
13	Φυσικό χυμό 100%	○	○	○	○	○	○	Πόσα ποτήρια; …………….	
14	Νέκταρ ή φρουτοποτό	○	○	○	○	○	○	Πόσα ποτήρια; …………….	
15	Σαλάτα (μαρούλι, ντομάτα, αγγούρι, πιπεριά)	○	○	○	○	○	○	Βλέπε εικόνα ………………	

		Πόσο συχνά τρως τα εξής;;						Πόσο σε μια μέρα;	
		Καμία	1 -2 φορές/ μήνα	1 φορά την εβδομάδα	2 φορές την εβδομάδα	3-6 φορές την εβδομάδα	Κάθε μέρα		
16	Λαδερά (Φασολάκια ή μπάμιες ή αγκινάρες ή μελιτζάνα ή κολοκυθάκι ή σπανακόρυζο)	○	○	○	○	○	○	Βλέπε εικόνα	
17	Χόρτα	○	○	○	○	○	○	Πόσα τεμάχια;	
18	Λάχανο ή Μπρόκολο ή Κουνουπίδι	○	○	○	○	○	○	Βλέπε εικόνα	
19	Παντζάρι ή αρακάς ή καλαμπόκι	○	○	○	○	○	○	Βλέπε εικόνα	
20	Λευκό τυρί (φέτα ή ανθότυρο)	○	○	○	○	○	○	Βλέπε εικόνα	
21	Κίτρινο τυρί (κασέρι, γραβιέρα ή γκούντα)	○	○	○	○	○	○	Πόσες φέτες;	
22	Τυρί με χαμηλά λιπαρά	○	○	○	○	○	○	Πόσες φέτες;	
23	Γάλα άσπρο	○	○	○	○	○	○	Πόσα ποτήρια;	
24	Γάλα σοκολατούχο ή γάλα με κακάο ή ρόφημα σοκολάτας	○	○	○	○	○	○	Πόσα ποτήρια;	

		Πόσο συχνά τρως τα εξής;						Πόσο σε μια μέρα;	
		Καμία	1 -2 φορές/ μήνα	1 φορά την εβδομάδα	2 φορές την εβδομάδα	3-6 φορές την εβδομάδα	Κάθε μέρα		
24α	Είναι το γάλα πλήρες ή χαμηλών λιπαρών (μπλε ή πράσινο);		2. ΠΛΗΡΕΣ (Μπλε) ☐			1. ΧΑΜΗΛΩΝ ΛΙΠΑΡΩΝ (Πράσινο) ☐			
25	Γιαούρτι	O	O	O	O	O	O	Πόσα κεσεδάκια;	
25α	Είναι το γιαούρτι πλήρες ή χαμηλών λιπαρών;		2. ΠΛΗΡΕΣ ☐			1. ΧΑΜΗΛΩΝ ΛΙΠΑΡΩΝ ☐			
26	Επιδόρπιο γιαουρτιού ή ρυζόγαλο ή κρέμα	O	O	O	O	O	O	Πόσα μπωλάκια;	
27	Αυγό	O	O	O	O	O	O	Πόσα τεμάχια;	
28	Σαλάμι ή ζαμπόν ή μπέικον	O	O	O	O	O	O	Πόσες φέτες;	
29	Μοσχάρι ή χοιρινό	O	O	O	O	O	O	Βλέπε εικόνα	
30	Κοτόπουλο ή γαλοπούλα	O	O	O	O	O	O	Βλέπε εικόνα	
31	Ψάρι	O	O	O	O	O	O	Βλέπε εικόνα	
32	Πίτσα	O	O	O	O	O	O	Πόσα κομμάτια;	

		Πόσο συχνά τρως τα εξής;						Πόσο σε μια μέρα;	
		Καμία	1 -2 φορές/ μήνα	1 φορά την εβδομάδα	2 φορές την εβδομάδα	3-6 φορές την εβδομάδα	Κάθε μέρα		
32α	Η πίτσα είναι:		1. ΑΠΛΗ ☐				2. ΣΠΕΣΙΑΛ ☐		
33	Χάμπουργκερ	○	○	○	○	○	○	Πόσα τεμάχια;	
34	Γύρος ή σουβλάκι σε πίτα ή ψωμί	○	○	○	○	○	○	Πόσα τεμάχια;	
35	Μπισκότο ή μπάρα δημητριακών	○	○	○	○	○	○	Πόσα τεμάχια;	
35α	Είναι το μπισκότο ή η μπάρα ολικής άλεσης;		1. ΝΑΙ ☐		0. ΟΧΙ ☐			2.ΜΕΡΙΚΕΣ ΦΟΡΕΣ ☐	
36	Βούτυρο	○	○	○	○	○	○	Πόσα κουταλάκια;	
37	Μαργαρίνη	○	○	○	○	○	○	Πόσα κουταλάκια;	
38	Μαγιονέζα ή έτοιμη σος	○	○	○	○	○	○	Πόσα κουταλάκια;	
38α	Είναι η μαγιονέζα ή σος χαμηλή σε λιπαρά;		1. ΝΑΙ ☐		0. ΟΧΙ ☐			2.ΜΕΡΙΚΕΣ ΦΟΡΕΣ ☐	
39	Μαρμελάδα ή μέλι	○	○	○	○	○	○	Πόσα κουταλάκια;	
40	Ξηροί καρποί	○	○	○	○	○	○	Βλέπε εικόνα	
41	Τηγανητές πατάτες	○	○	○	○	○	○	Βλέπε εικόνα	

		Πόσο συχνά τρως τα εξής;						Πόσο σε μια μέρα;	
		Καμία	1 -2 φορές/ μήνα	1 φορά την εβδομάδα	2 φορές την εβδομάδα	3-6 φορές την εβδομάδα	Κάθε μέρα		
42	Πατατάκια ή ποπ κορν ή γαριδάκια	○	○	○	○	○	○	Βλέπε εικόνα	
43	Παγωτό	○	○	○	○	○	○	Πόσες μπάλες;	
44	Κέικ ή κρουασάν	○	○	○	○	○	○	Πόσες φέτες;	
45	Τυρόπιτα ή σπανακόπιτα ή μπουγάτσα	○	○	○	○	○	○	Πόσα τεμάχια;	
46	Αναψυκτικό	○	○	○	○	○	○	Πόσα κουτάκια;	
46α	Είναι το αναψυκτικό λάιτ;		1. ΝΑΙ ☐		0. ΟΧΙ ☐				
47	Σοκολάτα ή γκοφρέτα	○	○	○	○	○	○	Βλέπε εικόνα	
48	Μερέντα	○	○	○	○	○	○	Πόσα κουταλάκια;	
49	Πόσο συχνά τρως εκτός σπιτιού ή παραγγέλνετε απ' έξω	○	○	○	○	○	○		
50	Πόσα κυρίως γεύματα και μικρογεύματα (κολατσιό) κάνεις συνήθως σε μια μέρα;	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	Πόσα κάνεις μπροστά στην TV ή τον υπολογιστή;	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6
51	Πόσο συχνά τρως το γεύμα σου μπροστά στην τηλεόραση ή τον υπολογιστή;	○ Ποτέ/Σπάνια	○ 1-2 φορές/ εβδομάδα	○ 3-4 φορές/ εβδομάδα	○ 5-6 φορές/εβδ	○ Κάθε μέρα			
52	Πόσες ημέρες την εβδομάδα τρως συνήθως πρωινό γεύμα;	○ 1 ημέρα	○ 2 ημέρες	○ 3 ημέρες	○ 4 ημέρες	○ 5 ημέρες	○ 6 ημέρες	○ 7 ημέρες	
53	Πόσο συχνά τρως τα γεύματά σου μαζί με όλη την οικογένεια ή με κάποιο γονέα σου (μητέρα, πατέρας);	○ Ποτέ/Σπάνια	○ 1-2 φορές/ εβδομάδα	○ 3-4 φορές/ εβδομάδα	○ 5-6 φορές/εβδ	○ Κάθε μέρα			

Ζ. Ερωτηματολόγιο αξιολόγησης τάσεων απέναντι στο φαγητό

Για κάθε μια από τις παρακάτω ερωτήσεις κυκλώστε τον αριθμό που υποδεικνύει το βαθμό σιγουριάς που δίνετε στον εαυτό σας ώστε να κάνετε αυτά που ζητούνται στην κάθε ερώτηση (και όχι το αν θα θέλατε να τα κάνετε). Έτσι π.χ για το **1**: καθόλου σίγουρος/η να κάνω αυτό που αναφέρεται στην ερώτηση και για το **5** : πάρα πολύ σίγουρος/η να κάνω αυτό που αναφέρεται αντίστοιχα. Σημειώστε μια μόνο απάντηση.

	Καθόλου σίγουρος	**Λίγο σίγουρος**	**Απλά σίγουρος**	**Πολύ σίγουρος**	**Πάρα πολύ σίγουρος**
	1	**2**	**3**	**4**	**5**
Κατά πόσο είσαι σίγουρος/η ότι... :					
1. μπορείς να καταναλώσεις **μικρότερες μερίδες** φαγητού;	☐	☐	☐	☐	☐
2. μπορείς να φας ένα σνακ στο σχολείο **από το σπίτι**;	☐	☐	☐	☐	☐
3. μπορείς να **περιορίσεις τα τηγανητά και λιπαρά τρόφιμα**, όπως τσιπς, πίτσες, σοκολάτα;	☐	☐	☐	☐	☐
4. αν αποφασίσεις να φάς **φρούτο κάθε μέρ**α μπορείς να το κάνεις;	☐	☐	☐	☐	☐
5. θα κατανάλωνες για **επιδόρπιο** το **αγαπημένο σου φρούτο** στη θέση ενός **γλυκού**;	☐	☐	☐	☐	☐
6. αν αποφασίσεις να φας **σαλάτα κάθε μέρα** μπορείς να το κάνεις;	☐	☐	☐	☐	☐
7. μπορείς να προσθέσεις **τα αγαπημένα σου λαχανικά στο αγαπημένο σου σάντουιτς**;	☐	☐	☐	☐	☐
8. μπορείς **να φας μαγειρεμένα λαχανικά με το φαγητό σου** 2 με 3 φορές την εβδομάδα;	☐	☐	☐	☐	☐
9.μπορείς **να προετοιμάσεις μόνος σου/μόνη σου το αγαπημένο σου φρούτο ή λαχανικό** για να φας;	☐	☐	☐	☐	☐
10. θα κατανάλωνες στο **πρωινό σου δημητριακά**;	☐	☐	☐	☐	☐
11. μπορείς να πιεις **ένα ποτήρι από τον αγαπημένο σου 100% χυμό φρούτων για πρωινό**;	☐	☐	☐	☐	☐
12. θα κατανάλωνες ένα **ποτήρι φρέσκου χυμού φρούτων ή 100% φυσικό χυμό φρούτων** ως σνακ;	☐	☐	☐	☐	☐
13. θα κατανάλωνες **δημητριακά ή μπισκότα ολικής άλεσης** στη θέση **κανονικών**;	☐	☐	☐	☐	☐
14. θα κατανάλωνες ένα **αναψυκτικό light** στη θέση **κανονικού αναψυκτικού**;	☐	☐	☐	☐	☐
15. θα έβαζες στο ψωμί **μαργαρίνη** στη θέση **βουτύρου**;	☐	☐	☐	☐	☐
16. αν αποφασίσεις να φας **ψάρι 1 φορά την εβδομάδα** μπορείς να το κάνεις;	☐	☐	☐	☐	☐
17. **θα αγόραζες προϊόντα χαμηλά σε λιπαρά** στη θέση **κανονικών προϊόντων** κατά την επίσκεψή σου στο σούπερ μάρκετ;	☐	☐	☐	☐	☐
18. θα κατανάλωνες για σνακ ή φαγητό **κάτι διαφορετικό** από τους φίλους σου όταν είσαι μαζί τους;	☐	☐	☐	☐	☐
19. αν **δεν υπήρχαν γλυκίσματα** στο σπίτι, **δεν θα τα κατανάλωνες** και εσύ συχνά;	☐	☐	☐	☐	☐
20. αν υπήρχαν **περισσότερα φρούτα και λαχανικά** στο σπίτι, θα κατανάλωνες και **εσύ** περισσότερα την ημέρα;	☐	☐	☐	☐	☐
21. αν υπήρχαν **πιο υγιεινά σνακ στο κυλικείο** του σχολείου, θα τα **κατανάλωνες και εσύ** πιο συχνά;	☐	☐	☐	☐	☐
22. αν στην τηλεόραση **διαφημίζονταν πιο συχνά τα υγιεινά τρόφιμα, θα τα κατανάλωνες** κι εσύ συχνά;	☐	☐	☐	☐	☐
23. Κατά πόσο πιστεύεις ότι επηρεάζεσαι από τους φίλους σου στην επιλογή σου για κάποιο σνακ;	☐	☐	☐	☐	☐

ΣΤ. ΣΩΜΑΤΟΜΕΤΡΗΣΕΙΣ

(συμπληρώνεται από τους ερευνητές)

1. Βάρος (χωρίς παπούτσια) σε Kg		2. Ύψος (χωρίς παπούτσια) σε cm	
3. Περιφέρεια μέσης σε cm		4. Περιφέρεια λεκάνης (cm)	
5. % Λίπος σώματος (αποτελέσματα από TANITA):		6. Λιπώδης μάζα σώματος:	
7. Συστολική πίεση:	8. Διαστολική πίεση:	9. Σφυγμοί	

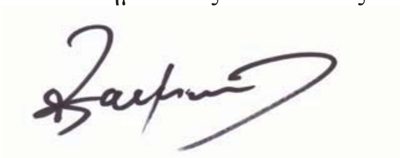
ΓΕΩΠΟΝΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ
ΤΜΗΜΑ ΕΠΙΣΤΗΜΗΣ ΚΑΙ ΤΕΧΝΟΛΟΓΙΑΣ ΤΡΟΦΙΜΩΝ
ΜΟΝΑΔΑ ΔΙΑΤΡΟΦΗΣ ΤΟΥ ΑΝΘΡΩΠΟΥ
Ιερά Οδός 75, 11855 Αθήνα, Τηλ: 210 5294945

Αγαπητέ γονέα / κηδεμόνα,

Η Μονάδα Διατροφής του Ανθρώπου του Τμήματος Επιστήμης και Τεχνολογίας Τροφίμων του Γεωπονικού Πανεπιστημίου Αθηνών με την άδεια του Υπουργείου Εθνικής Παιδείας και Θρησκευμάτων και την υποστήριξη της Γενικής Γραμματείας Καταναλωτή και άλλων φορέων έχουν ξεκινήσει μία Πανελλήνια Έρευνα με τίτλο: «**Εκτίμηση επιπέδων και αιτιολογίας παιδικής και εφηβικής παχυσαρκίας στην Ελλάδα**», που έχει την έγκριση του Παιδαγωγικού Ινστιτούτου.
Στα πλαίσια αυτής της έρευνας διανέμεται στο σχολείο του παιδιού σας ερωτηματολόγιο, το οποίο εκτιμά τις διατροφικές συνήθειες, την σωματική δραστηριότητα και την διατροφική συμπεριφορά των μαθητών. Με την παρούσα επιστολή θα σας παρακαλούσαμε να δώσετε τη συναίνεσή σας, ώστε το παιδί σας να απαντήσει στο προαναφερόμενο ερωτηματολόγιο. Θα θέλαμε να σας ενημερώσουμε ότι τα στοιχεία είναι απόρρητα και θα μας βοηθήσουν στην προαγωγή της επιστημονικής γνώσης στο χώρο της Υγείας και της διατροφής ειδικότερα. Παράλληλα, παρακαλούμε να απαντήσετε κι εσείς στο επισυναπτόμενο ερωτηματολόγιο που απευθύνεται στους γονείς. Τα στοιχεία που θα μας δώσετε θα διευκολύνουν την ορθότερη εξαγωγή συμπερασμάτων.

Σας ευχαριστούμε εκ των προτέρων για τη συνεργασία.

Ο Επιστημονικός Υπεύθυνος



Αντώνης Ζαμπέλας
Αναπληρωτής Καθηγητής

Ο/Η κάτωθι υπογεγραμμένος/-η

………………………………………...του…...……………......... δηλώνω

ότι επιτρέπω στον/-ην υιό/θυγατέρα μου…………………………………............... να απαντήσει στο ερωτηματολόγιο, που διανέμεται στο σχολείο του, για τις ανάγκες της έρευνας με τίτλο «**Εκτίμηση επιπέδων και αιτιολογίας παιδικής και εφηβικής παχυσαρκίας στην Ελλάδα**».

Ημερομηνία:…/…/……
Τόπος:…………..
Υπογραφή:

ΕΡΩΤΗΜΑΤΟΛΟΓΙΟ ΓΟΝΕΩΝ

ΗΜΕΡΟΜΗΝΙΑ: __/__/____ **ΚΩΔΙΚΟΣ:**

Το ερωτηματολόγιο συμπληρώθηκε από:

Μητέρα ☐

Πατέρα ☐

Τους 2 γονείς ☐

Α. ΔΗΜΟΓΡΑΦΙΚΑ & ΑΝΘΡΩΠΟΜΕΤΡΙΚΑ ΧΑΡΑΚΤΗΡΙΣΤΙΚΑ ΓΟΝΕΩΝ

1.Υπηκοότητα πατέρα:						**2.Υπηκοότητα Μητέρας:**					
3. Ηλικία πατέρα:			**4. Βάρος πατέρα (κιλά):**				**5.Ύψος πατέρα (εκατοστά):**				
6. Ηλικία μητέρας:			**7. Βάρος μητέρας (κιλά):**				**8.Ύψος μητέρας (εκατοστά):**				
9.Τόπος κατοικίας πατέρα:	**Νομός:**			**Πόλη:**			**Τ.Κ:**				
10.Τόπος κατοικίας μητέρας:	**Νομός:**			**Πόλη:**			**Τ.Κ:**				

Β. ΚΟΙΝΩΝΙΚΟ-ΟΙΚΟΝΟΜΙΚΑ ΧΑΡΑΚΤΗΡΙΣΤΙΚΑ ΓΟΝΕΩΝ

1. Επάγγελμα πατέρα:

1. Άνεργος ☐
2. Ελεύθ. Επαγγελματίας ☐
3. Ιδιωτ. Υπάλληλος ☐
4. Δημ. Υπάλληλος ☐
5. Συνταξιούχος ☐

2. Περιγράψτε το είδος εργασίας του πατέρα σημειώνοντας ένα μόνο νούμερο στην παρακάτω κλίμακα:

Χειρωνακτική			Μεικτή				Πνευματική		
1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. Εισόδημα πατέρα:

1. <10500€ ☐
2. 10500-12000 € ☐
3. 12000-30000 € ☐
4. 30000-70000€ ☐
5. Άνω των 70000€ ☐

4. Επάγγελμα μητέρας:

1. Άνεργη ☐
2. Οικιακά ☐
3. Ελεύθ. Επαγγελματίας ☐
4. Ιδιωτ. Υπάλληλος ☐
5. Δημ. Υπάλληλος ☐
6. Συνταξιούχος ☐

5. Περιγράψτε το είδος εργασίας της μητέρα σημειώνοντας ένα μόνο νούμερο στην παρακάτω κλίμακα:

Χειρωνακτική			Μεικτή				Πνευματική		
1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

6. Εισόδημα μητέρας:

1. <10500€ ☐
2. 10500-12000 € ☐
3. 12000-30000 € ☐
4. 30000-70000€ ☐
5. Άνω των 70000€ ☐

7. Σημειώστε στην παρακάτω κλίμακα πόσο ικανοποιημένος είναι ο πατέρας από το εισόδημά του;

1. Καθόλου	2. Λίγο	3. Μέτρια	4. Πολύ	5. Πάρα πολύ
☐	☐	☐	☐	☐

8. Σημειώστε στην παρακάτω κλίμακα πόσο ικανοποιημένη είναι η μητέρα από το εισόδημά της;

1. Καθόλου	2. Λίγο	3. Μέτρια	4. Πολύ	5. Πάρα πολύ
☐	☐	☐	☐	☐

9. Συνολικά έτη σπουδών πατέρα (Συνυπολογίστε τις σπουδές σας από το δημοτικό, γυμνάσιο, λύκειο, ΑΤΕΙ, Πανεπιστήμιο, επιμορφώσεις, μεταπτυχιακά):			**10. Συνολικά έτη σπουδών μητέρας (Συνυπολογίστε τις σπουδές σας από το δημοτικό, γυμνάσιο, λύκειο, ΑΤΕΙ , Πανεπιστήμιο, επιμορφώσεις, μεταπτυχιακά):**		

11. Η κατοικία σας είναι ιδιόκτητη;

1.ΝΑΙ ☐

0. ΟΧΙ ☐

Γ. ΠΛΗΡΟΦΟΡΙΕΣ ΣΧΕΤΙΚΑ ΜΕ ΤΗΝ ΕΓΚΥΜΟΣΥΝΗ

1. Βάρος μητέρας πριν την εγκυμοσύνη (κιλά):				**2. Αύξηση βάρους κατά την εγκυμοσύνη (κιλά):**			
3. Εβδομάδες κύησης:				**4. Ηλικία μητέρας κατά τον τοκετό**			

5. Κάπνισμα <u>κατά</u> την εγκυμοσύνη:

0. Όχι ☐
1. 1-9 τσιγάρα / ημέρα ☐
2. 10-20 τσιγάρα / ημέρα ☐
3. 20 ή περισσότερα τσιγάρα/ημέρα ☐

6. Κάπνισμα <u>πριν</u> την εγκυμοσύνη:

0. Όχι ☐
1. 1-9 τσιγάρα / ημέρα ☐
2. 10-20 τσιγάρα / ημέρα ☐
3. 20 ή περισσότερα τσιγάρα / ημέρα ☐

7. Κατανάλωση αλκοόλ <u>κατά</u> την εγκυμοσύνη (ημερησίως):

0. Καθόλου ☐
1. 1 μερίδα ποτού ☐
2. 2 η περισσότερες μερίδες ποτών ☐

8. Κατανάλωση καφέ κατά την εγκυμοσύνη (ημερησίως):

0. Καθόλου ☐
1. 1 φλιτζάνι καφέ ☐
2. 2 ή περισσότερα φλιτζάνια καφέ ☐

9. Βάρος γέννησης παιδιού (γραμ.):					**10. Ύψος γέννησης παιδιού (εκατ.):**		

Δ. ΠΛΗΡΟΦΟΡΙΕΣ ΣΧΕΤΙΚΑ ΜΕ ΤΟΝ ΘΗΛΑΣΜΟ

1. Πόσους μήνες θήλασε συνολικά η μητέρα;			**2. Πόσους μήνες θήλασε η μητέρα αποκλειστικά;**		
3. Σε ποιο μήνα έγινε η εισαγωγή σκόνης γάλακτος:					

4. Κάπνισμα <u>κατά</u> τον θηλασμό:

0. Όχι ☐
1. 1-9 τσιγάρα / ημέρα ☐
2. 10-20 τσιγάρα / ημέρα ☐
3. 20 ή περισσότερα τσιγάρα / ημέρα ☐

5. Κατανάλωση αλκοόλ <u>κατά</u> τον θηλασμό (ημερησίως):

0. κανένα ποτήρι ☐
1. 1 ποτήρι ☐
2. 2 ή περισσότερα ποτήρια ☐

Ε. ΠΛΗΡΟΦΟΡΙΕΣ ΣΧΕΤΙΚΑ ΜΕ ΤΗ ΔΙΑΤΡΟΦΗ ΤΟΥ ΠΑΙΔΙΟΥ

1. Σημειώστε ποιος ασχολείται περισσότερο με τη σίτιση-διατροφή του παιδιού στο σπίτι; Σημειώστε μόνο δύο (2) από τις πιθανές απαντήσεις, επιλέγοντας αυτούς που ασχολούνται περισσότερο.

α. Μητέρα:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
β. Ο πατέρας:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
γ. Η γιαγιά/ο παππούς:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
δ. Βοηθητικό προσωπικό:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
ε. Άλλος:	1. ΝΑΙ ☐	0. ΟΧΙ ☐

2. Σημειώστε παρακάτω κατά πόσο καλή/υγιεινή θεωρείτε τη διατροφή του παιδιού σας; (1: Καθόλου καλή/υγιεινή, 10: Πολύ καλή/υγιεινή).

1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. Σημειώστε ποια από τα παρακάτω τρόφιμα δεν αρέσουν στο παιδί σας και δεν τα καταναλώνει καθόλου ή τα καταναλώνει σπάνια:

α. Φρούτα:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
β. Λαχανικά:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
γ. Όσπρια:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
δ. Τρόφιμα ολικής αλέσεως:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
ε. Κρέας:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
στ. Ψάρι:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
ζ. Γιαούρτι:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
η. Τυριά:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
θ. Γάλα:	1. ΝΑΙ ☐	0. ΟΧΙ ☐

4. Σημειώστε ποια από τα παρακάτω τρόφιμα αρέσουν στο παιδί σας και τα καταναλώνει πολύ συχνά;

α. Γλυκά (σοκολάτα, γκοφρέτες, παγωτά)	1. ΝΑΙ ☐	0. ΟΧΙ ☐
β. Λαχανικά	1. ΝΑΙ ☐	0. ΟΧΙ ☐
γ. Φρούτα	1. ΝΑΙ ☐	0. ΟΧΙ ☐
δ. Αλμυρά σνακ (πατατάκια, κράκερς, γαριδάκια)	1. ΝΑΙ ☐	0. ΟΧΙ ☐
ε. Κρέας:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
στ. Ψάρι	1. ΝΑΙ ☐	0. ΟΧΙ ☐
ζ. Γιαούρτι	1. ΝΑΙ ☐	0. ΟΧΙ ☐
η. Τυριά	1. ΝΑΙ ☐	0. ΟΧΙ ☐
θ. Γάλα	1. ΝΑΙ ☐	0. ΟΧΙ ☐
ι. Αναψυκτικά:	1. ΝΑΙ ☐	0. ΟΧΙ ☐

5. Πόσο συχνά βγαίνετε έξω για φαγητό ή παραγγέλνετε απ' έξω;

1. Ποτέ ☐
2. 1-2 φορές το μήνα ☐
3. 3-4 φορές το μήνα ☐
4. 2 φορές την εβδομάδα ☐
5. 3 ή περισσότερες φορές την εβδομάδα ☐

6. Τι επιλέγεται συχνότερα όταν τρώτε εκτός σπιτιού ή παραγγέλνετε φαγητό απ' έξω; Σημειώστε μόνο δύο (2) από τις πιθανές απαντήσεις, αυτές που επιλέγεται συχνότερα.

α. Κρεατικά:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
β. Σουβλάκια:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
γ. Πίτσα:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
δ. Ζυμαρικά:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
ε. Ψάρι:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
στ. Θαλασσινά:	1. ΝΑΙ ☐	0. ΟΧΙ ☐
ζ. Fast Food:	1. ΝΑΙ ☐	0. ΟΧΙ ☐

7. Πόσο συχνά κατά τη διάρκεια της εβδομάδας τρώει όλη η οικογένεια μαζί;	8. Ποιο γεύμα της ημέρας τρωει συνήθως όλη η οικογένεια μαζί ;	9. Πόσο συχνά τρωει όλη η οικογένεια μαζί βλέποντας τηλεόραση;
	1. Κανένα ☐	
1. Ποτέ ☐	2. Πρωινό ☐	1. Ποτέ ☐
2. 1-2 φορές /εβδομάδα ☐	3. Μεσημεριανό ☐	2. 1-2 φορές/εβδομ ☐
3. 3-4 φορές /εβδομάδα ☐	4. Βραδινό ☐	3. 3-4 φορές/εβδομ ☐
4. 5-6 φορές / εβδομάδα ☐	5. Όλα τα παραπάνω ☐	4. 5-6 φορές/εβδομ ☐
5. Καθημερινά ☐		5. Καθημερινά ☐

10. Ποια πηγή πληροφόρησης για την διατροφή του παιδιού σας εμπιστεύεστε περισσότερο; Σημειώστε μόνο δύο (2) από τις πιθανές απαντήσεις, αυτές που εμπιστεύεστε περισσότερο

α. ΜΜΕ (τηλεόραση, ραδιόφωνο, έντυπος τύπος)	1. ΝΑΙ ☐	0. ΟΧΙ ☐
β. Παιδίατρος ή άλλος επιστήμονας υγείας (π.χ. άλλοι ιατροί, διαιτολόγοι)	1. ΝΑΙ ☐	0. ΟΧΙ ☐
γ. Γονείς	1. ΝΑΙ ☐	0. ΟΧΙ ☐
δ. Συγγενείς, φίλοι	1. ΝΑΙ ☐	0. ΟΧΙ ☐
ε. Άλλο (διευκρινίστε)	……………………............	

11. Αν θα μπορούσατε να αλλάξετε κάτι στην καθημερινή διατροφή του παιδιού σας τι θα ήταν αυτό; Ποια τρόφιμα/ ροφήματα θα μειώνατε και ποια θα αυξάνατε; Σημειώστε μόνο δύο (2) από τις πιθανές απαντήσεις, αυτές που θεωρείται σημαντικότερες.

Τρόφιμο	Αύξηση		Μείωση	
α. Αμυλούχα-Δημητριακά (ψωμί, μακαρόνια, ρύζι, πατάτες)	1. ΝΑΙ ☐	0. ΟΧΙ ☐	1. ΝΑΙ ☐	0. ΟΧΙ ☐
β. Γαλακτοκομικά	1. ΝΑΙ ☐	0. ΟΧΙ ☐	1. ΝΑΙ ☐	0. ΟΧΙ ☐
γ. Γλυκά	1. ΝΑΙ ☐	0. ΟΧΙ ☐	1. ΝΑΙ ☐	0. ΟΧΙ ☐
δ. Αναψυκτικά	1. ΝΑΙ ☐	0. ΟΧΙ ☐	1. ΝΑΙ ☐	0. ΟΧΙ ☐
ε. Χυμούς	1. ΝΑΙ ☐	0. ΟΧΙ ☐	1. ΝΑΙ ☐	0. ΟΧΙ ☐
στ. Λίπη και έλαια	1. ΝΑΙ ☐	0. ΟΧΙ ☐	1. ΝΑΙ ☐	0. ΟΧΙ ☐
ζ. Κόκκινο κρέας (μοσχάρι, χοιρινό, αρνί, συκώτι)	1. ΝΑΙ ☐	0. ΟΧΙ ☐	1. ΝΑΙ ☐	0. ΟΧΙ ☐
η. Αυγά	1. ΝΑΙ ☐	0. ΟΧΙ ☐	1. ΝΑΙ ☐	0. ΟΧΙ ☐
θ. Λαχανικά	1. ΝΑΙ ☐	0. ΟΧΙ ☐	1. ΝΑΙ ☐	0. ΟΧΙ ☐
ι. Φρούτα	1. ΝΑΙ ☐	0. ΟΧΙ ☐	1. ΝΑΙ ☐	0. ΟΧΙ ☐
κ. Άλλο (διευκρινίστε)	……………………….		………………………..	

12. Δίνετε στο παιδί σας συστηματικά κάποιου είδος συμπλήρωμα διατροφής;

α. Πολυβιταμίνες	1. ΝΑΙ ☐	0. ΟΧΙ ☐
β. Σίδηρο	1. ΝΑΙ ☐	0. ΟΧΙ ☐
γ. Βιταμίνη Ε	1. ΝΑΙ ☐	0. ΟΧΙ ☐
δ. Βιταμίνη C	1. ΝΑΙ ☐	0. ΟΧΙ ☐
ε. Βιταμίνες συμπλέγματος Β	1. ΝΑΙ ☐	0. ΟΧΙ ☐
στ. Άλλο (διευκρινίστε)	……………………….	

13. Θεωρείτε οτι το βάρος του παιδιού σας, για την ηλικία του είναι:

1. Χαμηλότερο του φυσιολογικού ☐
2. Φυσιολογικό ☐
3. Αυξημένο ☐

ΣΤ. ΠΛΗΡΟΦΟΡΙΕΣ ΣΧΕΤΙΚΑ ΜΕ ΤΗ ΣΩΜΑΤΙΚΗ ΔΡΑΣΤΗΡΙΟΤΗΤΑ

1. Πως θα χαρακτηρίζατε την καθημερινή σωματική δραστηριότητα (άσκηση) του παιδιού σας;

1. Πολύ χαμηλή ☐
2. Χαμηλή ☐
3. Κανονική-Ικανοποιητική ☐
4. Έντονη ☐
5. Πολύ έντονη ☐

2. Συμπληρώστε πόσες ώρες συνολικά στον ελεύθερο χρόνο σας βλέπετε τηλεόραση/ DVD ή παίζετε ηλεκτρονικά παιχνίδια ή περιηγείστε στο ίντερνετ ;

	Καθημερινές	Σαββατοκύριακα
Α. Ο πατέρας	……………..	……………..
Β. Η μητέρα	……………..	……………...

3. Στον ελεύθερο χρόνο σας κάνετε κάποιο είδος άσκησης όπως για παράδειγμα περίπατο με έντονο ρυθμό ή τρέξιμο (τζοκινγκ) για τουλάχιστον 30 λεπτά;

3.α. Εάν απαντήσατε ΝΑΙ στην ερώτηση 3, τότε πόσο συχνά μέσα στην εβδομάδα κάνετε αυτό το είδος άσκησης;

Α. Ο πατέρας:	1. ΝΑΙ ☐	0. ΟΧΙ ☐	1. 1 φορά ☐	2. 2-3 φορές ☐	3. 4-5 φορές ☐	4. 6 ή περισ. ☐
Β. Η μητέρα:	1. ΝΑΙ ☐	0. ΟΧΙ ☐	1. 1 φορά ☐	2. 2-3 φορές ☐	3. 4-5 φορές ☐	4. 6 ή περισ. ☐

3. β. Εάν απαντήσατε ΝΑΙ στην ερώτηση 3, τότε πόσο συχνά ασκείστε μαζί με όλη την οικογένεια ή με το παιδί σας;

0. Ποτέ/Σπάνια ☐ 1. Μερικές φορές ☐ 2. Συχνά ☐ 3. Πάντα ☐

Η. ΠΛΗΡΟΦΟΡΙΕΣ ΣΧΕΤΙΚΕΣ ΜΕ ΤΗ ΔΙΑΤΡΟΦΗ ΤΟΥ ΓΟΝΕΑ						
Σημείωσε ΠΟΣΟ ΣΥΧΝΑ καταναλώνεις τα παρακάτω τρόφιμα τον τελευταίο μήνα:						
	Συχνότητα κατανάλωσης σε μερίδες / εβδομάδα					
Δημητριακά ολικής άλεσης, πχ. ψωμί, ζυμαρικά, ρύζι (1 φέτα ή 1 φλιτζάνι)	Ποτέ	1-6	7-12	13-18	19-31	>32
Πατάτες (1 μικρή)	Ποτέ	1-4	5-8	9-12	13-18	>18
Φρούτα και χυμούς (1 μερίδα: Μικρά φρούτα κεράσια, φράουλες, σταφύλια - ½ φλ **ή** μεσαία φρούτα- μήλο, πορτοκάλι, αχλάδι - 1 μέτριο **ή** μεγάλα - πεπόνι, καρπούζι - 1 φέτα **ή** 1 ποτήρι χυμό)	Ποτέ	1-4	5-8	9-12	13-18	>18
Λαχανικά και σαλάτες (1 φλ ωμά ή ½ φλ βρασμένα)	Ποτέ	1-6	7-12	13-20	21-32	>33
Όσπρια (1 φλιτζάνι)	Ποτέ	<1	1-2	3-4	5-6	>6
Ψάρι και σούπες (120 γρ ή 1 πιάτο)	Ποτέ	<1	1-2	3-4	5-6	>6
Κόκκινο κρέας και προϊόντα του (120 γρ)	≤1	2-3	4-5	6-7	8-10	>10
Πουλερικά (120 γρ)	≤3	4-5	5-6	7-8	9-10	>10
Γαλακτοκομικά πλήρη σε λιπαρά (1 ποτήρι ή 1 κεσεδάκι ή 40 γρ τυρί)	≤10	11-15	16-20	21-28	29-30	>30
Ελαιόλαδο στην καθημερινή μαγειρική (1 κουτ σούπας)	Ποτέ	Σπάνια	<1	1-3	3-5	Καθημερινά
Αλκοολούχα ποτά (1 μερίδα ποτού: 120 ml κρασί ή 300 ml μπύρα ή 40 ml ουίσκι, βότκα, τζιν, ούζο)	<3	3	4	5	6	>7

Θ. ΕΡΩΤΗΜΑΤΟΛΟΓΙΟ ΑΝΙΧΝΕΥΣΗΣ ΑΣΘΜΑΤΟΣ ΚΑΙ ΑΛΛΕΡΓΙΚΩΝ ΠΑΘΗΣΕΩΝ ΣΤΑ ΠΑΙΔΙΑ	
1. Είχε ποτέ το παιδί σας στο παρελθόν «βράσιμο» ή σφύριγμα στο στήθος; ΝΑΙ ☐ ΟΧΙ ☐ **Αν απαντήσατε «όχι» παρακαλώ προχωρήστε στην ερώτηση 6**	**2. Είχε το παιδί σας «βράσιμο» ή σφύριγμα στο στήθος τους τελευταίους 12 μήνες;** ΝΑΙ ☐ ΟΧΙ ☐
3. Πόσα επεισόδια με «βράσιμο» ή σφύριγμα στο στήθος είχε το παιδί σας τους τελευταίους 12 μήνες; Κανένα ☐ 1 έως 3 ☐ 4 έως 12 ☐ Περισσότερα από 12 ☐	**4. Τους τελευταίους 12 μήνες, πόσο συχνά, κατά μέσο όρο, ξύπνησε το παιδί σας από «βράσιμο» ή σφύριγμα στο στήθος;** Ποτέ δεν ξύπνησε ☐ Λιγότερο από μία νύχτα την εβδομάδα ☐ Μια ή περισσότερες νύχτες την εβδομάδα ☐
5. Τους τελευταίους 12 μήνες, ήταν ποτέ τόσο σοβαρό το «βράσιμο» ή το σφύριγμα, ώστε να δυσκολεύεται να μιλήσει; ΝΑΙ ☐ ΟΧΙ ☐	**6. Είχε ποτέ το παιδί σας άσθμα;** ΝΑΙ ☐ ΟΧΙ ☐
7. Τους τελευταίους 12 μήνες, ακούστηκε «βράσιμο» ή «σφύριγμα» στο στήθος του παιδιού σας κατά τη διάρκεια ή μετά από άσκηση (τρέξιμο, παιχνίδι); ΝΑΙ ☐ ΟΧΙ ☐	**8. Τους τελευταίους 12 μήνες, είχε ποτέ το παιδί σας ξηρό βήχα τη νύχτα, που δεν οφειλόταν σε κρυολόγημα ή λοίμωξη του αναπνευστικού;** ΝΑΙ ☐ ΟΧΙ ☐
9. Είχε ποτέ το παιδί σας πρόβλημα με φτερνίσματα, συνάχι ή «βουλωμένη» μύτη, ενώ δεν ήταν κρυωμένο ή με γρίπη; ΝΑΙ ☐ ΟΧΙ ☐ **Αν απαντήσατε «όχι» παρακαλώ προχωρήστε στην ερώτηση 14**	**10. Τους τελευταίους 12 μήνες, είχε ποτέ το παιδί σας πρόβλημα με φτερνίσματα, συνάχι ή «βουλωμένη» μύτη, ενώ δεν ήταν κρυωμένο ή με γρίπη;** ΝΑΙ ☐ ΟΧΙ ☐

11. Τους τελευταίους 12 μήνες , μήπως μαζί με τα προβλήματα από τη μύτη υπήρχαν και συμπτώματα από τα μάτια όπως φαγούρα, κοκκινίλα, δάκρυα ;

ΝΑΙ ☐ ΟΧΙ ☐

12. Ποιο μήνα εμφανίστηκε αυτό το ρινικό πρόβλημα;

ΙΑΝΟΥΑΡΙΟ ☐ ΜΑΙΟ ☐ ΣΕΠΤΕΜΒΡΙΟ ☐
ΦΕΒΡΟΥΑΡΙΟ ☐ ΙΟΥΝΙΟ ☐ ΟΚΤΩΒΡΙΟ ☐
ΜΑΡΤΙΟ ☐ ΙΟΥΛΙΟ ☐ ΝΟΕΜΒΡΙΟ ☐
ΑΠΡΙΛΙΟ ☐ ΑΥΓΟΥΣΤΟ ☐ ΔΕΚΕΜΒΡΙΟ ☐

13. Τους τελευταίους 12 μήνες, πόσο επηρέασε τις καθημερινές δραστηριότητες του παιδιού σας αυτό το ρινικό πρόβλημα ;

ΚΑΘΟΛΟΥ ☐ ΛΙΓΟ ☐ ΑΡΚΕΤΑ ☐ ΠΟΛΥ ☐

14. Είχε ποτέ το παιδί σας αλλεργική ρινίτιδα (την άνοιξη) ;

ΝΑΙ ☐ ΟΧΙ ☐

15. Είχε ποτέ το παιδί σας εξάνθημα με φαγούρα που να έρχεται και να φεύγει , για τουλάχιστο 6 μήνες ;

ΝΑΙ ☐ ΟΧΙ ☐

Αν απαντήσατε «όχι» παρακαλώ προχωρήστε στην ερώτηση 21

16. Είχε ποτέ το παιδί σας αυτό το εξάνθημα με τη φαγούρα τους τελευταίους 12 μήνες

ΝΑΙ ☐ ΟΧΙ ☐

17. Εμφανίστηκε ποτέ αυτό το εξάνθημα με φαγούρα σε κάποια από παρακάτω σημεία: στους αγκώνες, πίσω από τα γόνατα, στους αστραγάλους, κάτω από τους γλουτούς, γύρο από το λαιμό, τα μάτια η τα αυτιά ;

ΝΑΙ ☐ ΟΧΙ ☐

18. Σε ποια ηλικία πρωτοεμφανίστηκε αυτό το εξάνθημα με τη φαγούρα ;

ΜΙΚΡΟΤΕΡΗ ΤΩΝ 2 ΕΤΩΝ ☐ 2-4 ΕΤΩΝ ☐
ΜΕΓΑΛΥΤΕΡΗ ΤΩΝ 5 ΕΤΩΝ ☐

19. Υπάρχει κάποιο διάστημα κατά τους τελευταίους 12 μήνες κατά το οποίο το εξάνθημα εξαφανίστηκε εντελώς ;

ΝΑΙ ☐ ΟΧΙ ☐

20. Τους τελευταίους 12 μήνες, πόσο συχνά, κατά μέσο όρο, έμεινε ξύπνιο το παιδί σας τη νύχτα εξαιτίας της φαγούρας από το εξάνθημα ;

Ποτέ τους τελευταίους 12 μήνες ☐
Λιγότερο από μία νύχτα την εβδομάδα ☐
Μια ή περισσότερες νύχτες την εβδομάδα ☐

21. Είχε ποτέ το παιδί σας έκζεμα ;

ΝΑΙ ☐ ΟΧΙ ☐

22. Το παιδί σας γεννήθηκε:

Φυσιολογικά ☐ Με καισαρική τομή ☐
Ήταν: Τελειόμηνο ☐ Πρόωρο ☐ Από δίδυμη κύηση ☐

23. Πήγε ποτέ το παιδί σας σε:

Βρεφονηπιακό Σταθμό ☐ Παιδικό Σταθμό ☐ Νηπιαγωγείο ☐
Τίποτα από τα παραπάνω ☐
Εάν ναι, σε ποια ηλικία ………… και για πόσο καιρό………………

24. Νοσηλεύτηκε σε μονάδα προώρων;

Ναι ☐ Όχι ☐
Εάν ναι, για πόσο διάστημα;……………..
Προβλήματα που παρουσίασε……………………………………………

25. . Έχει το παιδί σας άλλα αδέρφια;

ΝΑΙ ☐ ΟΧΙ ☐
Εάν ναι , αναφέρετε αναλυτικά τις ηλικίες των παιδιών σας και εάν έχουν / είχαν κάποια από τις ακόλουθες ασθένειες

Παιδί	**Ηλικία**	**Άσθμα**	**Αλλεργική ρινίτιδα**	**Έκζεμα**
Πρώτο				
Δεύτερο				
Τρίτο				

26. Είχε ποτέ η μητέρα του παιδιού κάποια από τις ακόλουθες ασθένειες :

Άσθμα ☐ Αλλεργική ρινίτιδα ☐ Έκζεμα ☐

27 . Είχε ποτέ η μητέρα του παιδιού κάποια από τις ακόλουθες ασθένειες :

Άσθμα ☐ Αλλεργική ρινίτιδα ☐ Έκζεμα ☐