ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
Εθνικόν και Καποδιστριακόν
Πανεπιστήμιον Αθηνών
ΙΔΡΥΘΕΝ ΤΟ 1837

ΠΜΣ

**«ΕΠΙΔΗΜΙΟΛΟΓΙΑ - ΜΕΘΟΔΟΛΟΓΙΑ ΕΡΕΥΝΑΣ
ΣΤΙΣ ΒΙΟΪΑΤΡΙΚΕΣ ΕΠΙΣΤΗΜΕΣ, ΤΗΝ ΚΛΙΝΙΚΗ ΠΡΑΞΗ ΚΑΙ ΤΗ ΔΗΜΟΣΙΑ ΥΓΕΙΑ»**

ΕΘΝΙΚΟ ΚΑΙ ΚΑΠΟΔΙΣΤΡΙΑΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ
ΙΑΤΡΙΚΗ ΣΧΟΛΗ

Τίτλος Διπλωματικής Εργασίας

Επιπολασμός υπέρβαρου και παχυσαρκίας σε αντιπροσωπευτικό δείγμα παιδιών σχολικής ηλικίας στην Ελλάδα και η συσχέτισή τους τις διατροφικές συνήθειες και συμπεριφορές.

Prevalence of Overweight and Obesity and their association with diet-related habits and behaviors in a representative sample of children in Greece.

Όνομα υποψηφίου
ΜΑΚΡΉ ΡΑΦΑΈΛΑ

ΑΘΗΝΑ, 2021

Η παρούσα Διπλωματική Εργασία εγκρίθηκε την 28.09.2020 και 17.12.2021

Εξεταστική επιτροπή:

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Prevalence of Overweight and obesity and their association with diet-related habits and behaviors in a representative sample of children in Greece: Results from Health Behavior in School-aged Children (HBSC) cross-sectional study.

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Abstract

Excessive body weight during adolescence represents a significant public health problem worldwide. Identifying factors associated with its development is crucial. Interactions between factors that lead to obesity are yet to be understood; however, diet-related behaviors and lifestyle factors can be influencing the development of obesity.

The aim of the current study was to estimate the prevalence of overweight and obesity in a representative sample of adolescents living in Greece and explored the association with diet-related behaviours. Self-reported data on weight, height, diet-related behaviours and habits were used from 3,.816 adolescents (1898 boys, 1918 girls) aged 11-, 13- and 15-years-old, participants in the Greek arm of the international Health Behaviour in School-Aged Children (HBSC) cross-sectional study during 2018. Overweight and obesity were defined using the 2007 WHO growth charts classification. Prevalence of overweight was 19.4% in the total sample, 24.1% for boys and 14.7% for girls, and prevalence of obesity was 5.3% in the total sample, 7.3% for boys and 3.4% for girls, respectively. Overweight (including obesity) was positively associated with male gender, low family affluence, skipping breakfast, being on a diet, and inversely associated with age, and being physically active. Eating rarely with the family was positively associated with overweight only among boys, and eating snacks/meals in front of screens only among girls. No association was noted for eating in fast-food restaurants, consuming vegetables, fruits, sweets, and sugar-sweetened beverages. Prevention of overweight by promoting active lifestyles and healthy behaviors that are modifiable should be a national public health priority.

Περίληψη

Το υπερβάλλων σωματικό βάρος την περίοδο της εφηβείας αποτελεί ένα σημαντικό πρόβλημα δημόσιας υγείας παγκοσμίως. Ο εντοπισμός των παραγόντων που σχετίζονται με την ανάπτυξή του είναι καίριας σημασίας. Οι συμπεριφορές που σχετίζονται με τη διατροφή και οι παράγοντες του τρόπου ζωής μπορούν να επηρεάσουν την ανάπτυξη της παχυσαρκίας.

Σκοπός της παρούσας μελέτης ήταν η εκτίμηση του επιπολασμού του υπέρβαρου και της παχυσαρκίας σε ένα αντιπροσωπευτικό δείγμα εφήβων που ζουν στην Ελλάδα και η διερεύνηση της συσχέτισης με συμπεριφορές που σχετίζονται με τη διατροφή. Χρησιμοποιήθηκαν δεδομένα αυτοαναφοράς για το βάρος, το ύψος, τις συμπεριφορές, και τις συνήθειες που σχετίζονται με τη διατροφή 3.816 εφήβων (1898 αγόρια, 1918 κορίτσια) ηλικίας 11, 13 και 15 ετών, συμμετέχοντες στο ελληνικό σκέλος της διεθνής συγχρονικής μελέτης «Health Behaviour in School-Aged Children» (HBSC,) κατά τη διάρκεια του 2018. Για τον ορισμό του υπέρβαρου και της παχυσαρκίας χρησιμοποιήθηκαν οι καμπύλες ανάπτυξης του 2007 του Παγκόσμιου Οργανισμού Υγείας (WHO). Ο επιπολασμός του υπέρβαρου ήταν 19,4% στο συνολικό δείγμα, 24,1% για τα αγόρια και 14,7% για τα κορίτσια, και ο επιπολασμός της παχυσαρκίας ήταν 5,3% στο συνολικό δείγμα, 7,3% για τα αγόρια και 3,4% για τα κορίτσια, αντίστοιχα. Το υπέρβαρο (συμπεριλαμβανομένης της παχυσαρκίας) είχε θετική συσχέτιση με το αρσενικό φύλο, τη χαμηλή οικογενειακή ευημερία, την παράλειψη πρωινού, τη δίαιτα και αρνητική συσχέτιση με την ηλικία και την σωματική δραστηριότητα. Η σπάνια κατανάλωση οικογενειακών γευμάτων συσχετίστηκε θετικά με το υπερβολικό βάρος μόνο στα αγόρια και η κατανάλωση σνακ/γευμάτων μπροστά στις οθόνες μόνο στα κορίτσια. Δεν σημειώθηκε καμία συσχέτιση με την κατανάλωση γευμάτων σε εστιατόρια fast-food, την κατανάλωση λαχανικών, φρούτων, γλυκών και ποτών με ζάχαρη.

Η πρόληψη εμφάνισης υπέρβαρου μέσω τροποποιήσιμων παραγόντων όπως η υιοθέτηση

ενός δραστήριου τρόπου ζωής και υγιεινών συμπεριφορών, πρέπει να αποτελεί προτεραιότητα για τη δημόσια υγεία.

Acknowledgments

My deep gratitude goes first to my professor and thesis supervisor Dr. Vasiliki Benetou, who expertly guided me through my thesis and her enthusiasm kept me constantly engaged with my research.

My appreciation also extends to Dr. Michalis Katsoulis, Dr Philippos Orphanos, and Afroditi Kanellopoulou for pointing me toward the statistics section and giving me the opportunity to expand my knowledge in relation to statistics.

The completion of this study could not have been possible without the approval of providing access and instructions by the members of the Research University Institute of Mental Health (EPIPSY) who conducted the HBSC study in Greece in 2018. I must express my very profound gratitude to Anna Kokkevi, Anastasios Fotiou, Clive Richardson, Eleftheria Kanavou, and Myrto Stavrou.

Introduction

Over the years, excess body weight during childhood and adolescence has emerged as one of the most serious public health problems globally (Di Cesare et al., 2019). Obesity epidemic is on the rise and, at the same time, major shifts in dietary patterns are occurring around the globe. World Health Organization (WHO) defines overweight and obesity as an abnormal or excessive fat accumulation that may impair health ("WHO | Overweight and obesity," 2020).

The burden of childhood Obesity

Childhood obesity has reached epidemic proportions, both in high and low-income countries, with the number of overweight and obese children having doubled or even tripled since 1970 (Wang and Lobstein, 2006). According to the World Health Organization (WHO), in 2016, 18% of children and adolescents, aged 5-19 years, were overweight and obese worldwide, while significant geographical variations in obesity rates were noted ("WHO | Overweight and obesity," 2016). The growing prevalence of childhood obesity has many implications for public health, and a higher risk of developing non-communicable chronic diseases (Lakshman et al., 2012). Childhood obesity has been associated with significant negative health issues, both in childhood and adulthood. Most importantly, overweight and obesity have important short and long-term adverse consequences on physical, mental and emotional health of the child and future adult (Di Cesare et al., 2019).

Time trends

The most recent data in regards to childhood obesity are found in the global NCD-RisC database, which was published in 2017 based on 2416 data sources (Abarca-Gómez et al., 2017). According to the cumulative analysis, between 1975 and 2016, the prevalence of obesity in children aged 5-19 years, increased from 0.7% to 5.6% in girls and from 0.9% to 7.8% in boys. It is emerging that obesity had an eight-fold increase between 1975 and 2016 (NCD-RisC. NCD Risk Factor Collaboration., 2017). In 1975, there were 5 million obese girls and 6 million obese boys aged 5-19 worldwide, while by 2016, the number of obese children and adolescents aged 5-19 rose to 50 million girls and 75 million boys (Abarca-Gómez et al., 2017; Di Cesare et al., 2019). In addition, the estimation for 2016, was that 213 million children between 5-19 years were overweight (Abarca-Gómez et al., 2017).

Geographic distribution

The highest levels of obesity are observed mainly in English-speaking regions, with the United States and New Zealand to have the highest prevalence of obesity for girls and boys, followed by the Mediterranean countries (Di Cesare et al., 2019). Countries that are surrounding the Mediterranean Sea, traditionally appear to have particularly high prevalence rates of overweight and obesity in children and adolescents (Tzotzas et al., 2008). According to data from the COSI (European Childhood Obesity Surveillance Initiative) epidemiological surveillance study, which examined trends in the prevalence of obesity in children aged 6-9 years in 21 European countries over time, it seemed that Southern European countries have the highest rates of severe obesity, with over 4% of the children (Spinelli et al., 2019). Particularly Greece appeared to have the highest rates of overweight and obesity compared to other countries (Nittari et al., 2020). One in two children was found to be either overweight or obese when the prevalence was calculated taking into account all three cycles of the COSI study conducted in 2007/2008, 2009/2010, and 2012/2013 (Spinelli et al., 2019).

Prevalence of childhood obesity in Greece

In Greece, overweight and obesity have reached epidemic proportions, to a greater extent than other European countries both among children and adolescents (Di Cesare et al., 2019; Nittari et al., 2020; Roditis et al., 2009; Spinelli et al., 2019; Tzotzas et al., 2008). With respect to adolescents, studies based on nationally representative samples are few, and the majority are not very recent (Georgiadis and Nassis, 2007; Kanellopoulou et al., 2021; Karayiannis et al., 2003; Kostopoulou et al., 2021; Patsopoulou et al., 2016; Roditis et al., 2009). During 2003, data from a representative sample of 14,456 adolescents aged 13-19 years showed that overweight and obesity reached 29.4% in boys and 16.7% in girls (Tzotzas et al., 2008), whereas in 2009, in data from 4786 children aged 10-12 years, overweight and obesity reached 42.8% among boys and 39.8% among girls (Farajian et al., 2011). In the context of the Health Behaviour in School-Aged Children (HBSC) survey, prevalence of obesity among adolescents in Greece had doubled in 2014 (3.9%) in comparison to 2002 (2.0%), whereas a slight decrease in comparison to 2014 was evident especially among the 11-old-year girls in 2018 (Inchley et al., 2020, 2017; Kokkevi, et al., 2015).

Definition and assessment of Childhood Obesity

Obesity derives from a positive energy balance between energy intake and energy expenditure over a prolonged period, with consequent accumulation of excess fat. Potential risk factors contribute to the cause of obesity, through one or more of the three following pathways. A greater caloric intake than children's requirements for normal growth; a lower calorie expenditure due to physical inactivity; or an alteration in metabolism that causes a caloric imbalance (Agras et al., 2004).

The assessment of childhood obesity is done by simple anthropometric indicators (Body Mass Index and waist circumference) (Barreira et al., 2014; Cole et al., 2000; Freedman et al., 1999), as direct body fat measurement methods are not available in daily practice. Body Mass Index (BMI) is a clinically valid index; it strongly correlates with adiposity (Field et al., 2003), adult adiposity (Freedman et al., 2005), cardiovascular disease factors (Freedman et al., 2007), and all-cause mortality ("American Heart Association Childhood Obesity Research Summit Report | Circulation," 2009). As height and weight are widely available measurements in daily practice, BMI is the most commonly used index for indirect measure of adiposity in children and adolescents (Katzmarzyk et al., 2007; Rolland-Cachera, 2011).

However, it is way more challenging and complicated to establish a standard BMI classification system for children than is for adults (Roberts et al., 2012; Rolland-Cachera, 2011). Spectacular changes in anthropometrics, fluctuations in growth rates during maturation, differences in race and gender, are factors to be considered for the identification of childhood obesity. Thus, the classification systems that have been developed are age-specific and sex-specific for a more precise estimation of the adiposity status in children and adolescents (Katzmarzyk et al., 2007; Roberts et al., 2012).

There is a lack of standard definition of overweight and obesity in children, in terms of references, cut-offs, and terminology used (Rolland-Cachera, 2011). Using different approaches to classify obesity often leads to misinterpretation, and therefore, ambiguous information in the literature, making comparisons between different countries estimations more complicated (Katzmarzyk et al., 2007). Two definitions of obesity are widely used to assess the prevalence of childhood overweight and obesity: The International Obesity Task Force (IOTF) definition (Cole et al., 2000; de Onis et al., 2007), and the World Health Organization (WHO) cut-offs.

In 2007, WHO issued a set of age-sex-specific classification cut offs for children and adolescents aged from 5 to 19. WHO growth charts are commonly used in individual level to examine children's' growth status (Roberts et al., 2012). The WHO growth reference reflects the normal development of children based on how they should grow under ideal conditions, regardless of nationality, socio-economic status, and the environment that they are exposed (Katzmarzyk et al., 2007; Onis, 2006). The classification of overweight and obesity relies on BMI centiles or standard deviation (SD) scores, both age and sex specific. Overweight is defined as more than 1SD above the median to 2SD above the median (equivalent to BMI 25 kg/m^2 at 19 years), and obesity as more than 2SD above the median (equivalent to BMI 30 kg/m^2 at 19 years) (de Onis et al., 2007).

The International Obesity Task Force (IOTF), in 2000, released BMI centiles to define childhood overweight and obesity, obtaining data from six large nationally representative cross-sectional surveys on growth. Cole and colleagues proposed a new methodology based on international data for BMI, and linked to the adult obesity cut off point of 25 and 30 kg/m^2 (Cole et al., 2000). The IOTF references constructed for ages 2-18-year-olds, by values of BMI at age 18 (Cole and Lobstein, 2012). A follow up paper few years later, added cut offs for three grades of thinness using similar methodology (Cole et al., 2007). Up until 2011, unlike WHO standards, IOTF cut offs could not be expressed as centiles (Cole and Lobstein, 2012). To tackle it, Cole and Lobstein, generate the cut offs based on the underlying LMS curves. As a result, the new cut offs were slightly different from the originals. Differences were limited to estimates of thinness in youngest age groups, however, did not considerably impact the estimates of prevalence of overweight and obesity. The new cut offs could then be expressed as BMI centiles or SD scores, enabling a direct comparison with other BMI references. Additionally, a new category of BMI≥35kg/m^2 for morbid obesity was derived by the extended IOTF cut offs (Cole and Lobstein, 2012). The extended International (IOTF) BMI cut-offs for thinness, overweight and obesity in children at 18 years are listed in **Table 1**, while the new cut offs derived from Cole and Lobstein (2012) for exact ages by month in children from 2-18 years, are available at the website of the International Association for the Study of Obesity. ("Obesity Classification," 2012).

Table 1: The revised international child cut-offs (IOTF) corresponding to the following body mass index (BMI) cut-offs at 18 years.

BMI (kg/m^2)	BMI classification
16	thinness grade 3
17	thinness grade 2
18,5	thinness grade 1
25	overweight
30	obesity
35	morbid obesity

Numerous definitions are used to estimate childhood obesity, which vary significantly in terms of references, cut offs, and terminology used. Yet, none of them is ideal (Rolland-Cachera, 2011). An internationally accepted definition is, undoubtedly, required to form a global perspective of the childhood obesity epidemic. However, the adoption of a standard reference across the globe is not expected until the near future (Rolland-Cachera, 2012).

Aetiology of Childhood Obesity

Childhood obesity is the byproduct of the interaction among a complex set of factors; genetics, environment, and ecological impact such as the family, community, and school (Kumar and Kelly, 2017).

The role of genetics and epigenetics

Evidence suggests that **genetic** background and parental overweight are central in determining obesity risk (Cheung and Mao, 2012; Sahoo et al., 2015). Studies in twins estimate heritability of BMI, waist circumference, and other anthropometric measures to be 40–70% in children and adults (Malis et al., 2005; Turula et al., 1990; Wardle et al., 2008). Notably, genetics alone cannot explain the increased prevalence of childhood obesity in recent decades (Anderson et al., 2014). Obesity rates are growing much faster than would be possible with genomic alterations. Therefore, the contribution of **epigenetics** suggested to play a critical role in the development of obesity.

Epigenetics is the study of heritable alterations which influence gene function without modifying the DNA sequence (Herrera et al., 2011). The microbiome, our «second genome», has higher plasticity than one's genome, which could be of benefit for tackling obesity to future generations through epigenetic mechanisms (Chang and Neu, 2015). Along with microbiome, neuroendocrine, and metabolic systems, epigenetics may have a key role in the development of obesity and Metabolic Syndrome (MetS) (Chang and Neu, 2015), with potential pathways not yet clearly identified. Microbial flora is more likely to be formed during fetal life and early infancy, than in adult life (Chang and Neu, 2015). Maternal weight before pregnancy and weight gain during pregnancy may trigger alterations in maternal microbiota, influencing the colonization in infants, and resulting in increased risk for being overweight (Collado et al., 2010). Whether the mode of delivery is vaginal or by cesarean section, seemed to have a major effect on the microbial flora and metabolic mechanisms of intestinal track, and a strong association with BMI in later life. Cesarean delivery is associated with a greater risk of developing obesity in adulthood (Chang and Neu, 2015; Chavarro et al., 2020; Darmasseelane et al., 2014). Another exposure in early life that could affect the development childhood obesity is nutrition (Ma et al., 2020). Breastfeeding is shown to have a protective effect against obesity (Ma et al., 2020; Rito et al., 2019; Yan et al., 2014). Breastfed infants found to have 5 times lower risk to develop obesity in later childhood, compared with those who were never breastfed, suggesting a protective role of breastfeeding in childhood obesity (Yan et al., 2014). The association is stronger when breastfeeding is provided for 7 months or longer, suggesting that duration of breastfeeding is inversely associated with the risk of overweight in adult life (Harder et al., 2005).

Environmental and ecological impact

Besides genetic predisposition, environmental factors including socio-demographic determinants and modifiable lifestyle factors, are related to the aetiology of childhood obesity (Dupuy et al., 2011). As Hippocrates first stated, health is a product of environmental factors, emphasizing the need for harmony between the individual, social, and natural environment. The built environment contributes to the level of self-regulation of the peoples' decision on physical activity and dietary behaviors at individual and community levels (Hobbs & Radley, 2020). These environmental aspects may contribute to the escalating obesity rates and the so called «obesogenic» environment (Townshend and Lake, 2017). Individuals or populations living in certain environments that are more «obesogenic» than others, may be more prone to weight gain and development of obesity (Swinburn et al., 1999). Interaction with various «micro-environments» that affect nutrition and physical activity (school, super-market, home, internet, television, promotions) may have an impact on weight.

Processed and energy dense foods

Food industry practices such as increased availability and affordability of processed and energy dense foods, along with effective marketing strategies, are important drivers for the obesity epidemic globally (Swinburn et al., 2011; Weihrauch-Blüher and Wiegand, 2018). Food marketing in children was recognized as a significant contributor to childhood obesity, influencing their food preferences, food requests, and hence, their consumption (Kelly et al., 2010). Children are a vulnerable audience that may not be able to recognize the sale tactics such as the hero's advertisements and the free toys rewards.

Increased availability of affordable, palatable, and energy-dense foods promotes the excess energy intake and weight gain from young age (Swinburn et al., 2011). Higher consumption of snacks, sugar-sweetened beverages, fast foods that contain excess fat, and foods with a high glycemic index, are food habits developed as a result of the «obesogenic» environment and globalization of food (Scharf and DeBoer, 2016; St-Onge et al., 2003). In addition, large portions and higher energy-dense foods, are shown to have an effect on the total energy intake of young children at meals (Fisher et al., 2007).

Food availability at schools play a key role in children's consumption patterns, therefore can provide an opportunity for childhood obesity prevention. Focusing on nutritious food and healthier options must be of a highest priority on every school agenda considering the possible impact in children's health and wellbeing (Welker et al., 2016). School-based nutrition policies and interventions in European countries targeting at healthy nutrition have been suggested by WHO since 2006 (WHO/Europe, 2006). Similarly, in USA, a significant process has been made through the years in terms of food and beverages quality provided at schools (Welker et al., 2016). Yet, there is a lot of work to be done in terms of an effective implementation of food policies at schools, besides, changing food habits in children it is incredibly challenging.

Studying the role of diet-related behaviours and dietary habits in the aetiology and prevention of overweight and obesity during childhood and adolescence has become increasingly important, since these behaviours and habits are formed early in life but also have the potential to be modified, if necessary, in the future.

Increased fast food consumption and eating out of home

Over the past few decades, eating habits and home environments have changed significantly. The increased fast food consumption and the trend of food away from home occurred simultaneously with higher childhood obesity rates (Mancino et al., 2014). More families in which both parents work, and lack of time, have led to an increased fast-food consumption and to a shift towards «convenience food», with an increased pre-packaged processed food consumption (St-Onge et al., 2003; WHO/Europe, 2006). Fast foods and foods away from home are often served in large portions, are high in added sugars and fats, and are less nutritious than home prepared food (Lin and Guthrie, 2012; Young and Nestle, 2002). The modern eating environment and, therefore, the greater tendency to eat out, affects the way the children eat. As a result, many children and adolescents get to be familiar with larger than appropriate portions, higher in fat and sugar foods, and high-energy-dense foods. That has an impact in their future eating behavior, as they grow up without learning or developing skills of how to prepare a meal or provide a healthy diet (WHO/Europe, 2006).

Frequency of eating fast food has also found to be associated with BMI and excessive fat in children (Krebs et al., 2007; St-Onge et al., 2003). Adolescent girls who ate fast food twice a week or more were found to be at a higher risk to increase their relative BMI over time (Thompson et al., 2004). In contrast, in a community based sample of 4746 adolescent students, French et al. did not find any association between frequency of fast food consumption and overweight status (French et al., 2001). Similarly, being overweight or obese was not associated with frequency of fast-food consumption in a school-aged children and adolescents in Greece (Tambalis et al., 2018). However, frequent fast-food consumption was strongly associated with other unhealthy dietary habits, such as skipping breakfast, and eating sweets or candy on a regular basis (Tambalis et al., 2018). Although not consistent, there is an increasing evidence suggesting an association between consumption of food away from home, particularly fast food, with the risk of obesity among children (Krebs et al., 2007; Mancino et al., 2014).

Eating behaviors

With respect to eating behaviors, skipping breakfast is reported to be an important risk factor for weight gain (Croezen et al., 2009), while habitual breakfast consumption, especially among children, is found to be a protective eating behavior against overweight and obesity (Blondin et al., 2016; Dupuy et al., 2011; Farajian et al., 2014). A vast literature suggests that skipping breakfast is associated with increased risk of becoming overweight or obese, and with elevated BMI (Croezen et al., 2009; Haug et al., 2009; Koca et al., 2017; Szajewska and Ruszczynski, 2010). Notably, a Swedish longitudinal study in adolescents with a 27-year follow up, showed that breakfast skipping in adolescence was an important predictor for development of MetS, central obesity and high fasting glucose in adulthood. Breakfast skippers found to have 2.18 times greater risk of central adiposity compared with breakfast consumers (Wennberg et al., 2015). Similar findings were reported in a longitudinal study with Australian 9-15-y-old children, were skipping breakfast was found to be associated with larger waist circumference, higher BMI, and higher cardiometabolic risk factors (Smith et al., 2010).

Frequency of family meals found to be protective against the development of overweight and obesity in adolescents and 10 years later (Berge et al., 2015). Having frequent family meals was associated with increased consumption of healthier food groups such as fruits and vegetables, with less unhealthy diet as it provides opportunities for parental modeling of healthier eating habits and behaviors, and with lower children's BMI (Dallacker et al., 2018; Larson et al., 2013).

Fruit and vegetable intake

Fruit and vegetable intake has shown to have a protective role in cardiovascular diseases and several cancers, and to reduce the adiposity level, as they are rich in fiber and micronutrients, and low in energy (Newby, 2009; Stea et al., 2018). However, the evidence concerning the association between overweight and fruit and vegetable intake is inconsistent (Janssen et al., 2005; Serra-Majem et al., 2006; Stea et al., 2018). A recent review concluded that the available data failed to support a protective role of fruit and vegetable intake to the risk of developing childhood obesity (Newby, 2009). However, the opposite has been shown to hold true (Roseman et al., 2007; Serra-Majem et al., 2006).

Sweets intake

The contribution of sweets intake to childhood obesity is not well established. Candies and confectionery are high in sugar and carbohydrates ("Top Food Sources of Dietary Components | EGRP/DCCPS/NCI/NIH," 2019), while chocolate is often high in fat, particularly saturated fat. Cocoa, which is a component of chocolate, is also rich in flavonoids and may result in some health benefits such as reduced risk of developing cardiovascular disease or stroke(Buitrago-Lopez et al., 2011), decreased levels of systolic and diastolic blood pressure, decreased levels of LDL cholesterol, and higher HDL cholesterol levels (Shrime et al., 2011). Recent meta-analyses suggested to consistent inverse associations of sweets/confectionery consumption with overweight and obesity (Gasser et al., 2016). A systematic review that compared estimates of the prevalence of overweight and obesity in school-aged youth from 34 countries, revealed a significant negative correlation between the frequency of sweets intake and likelihood of overweight in 91% of the countries examined (Janssen et al., 2005). That was statistically controlled for being on a weight loss diet, so findings are unrelated to participants' weight loss attempts (Janssen et al., 2005). Under-report of sweet intake by overweight individuals compared to normal weight counterparts or eating sweets less often but in greater portions are some of the possible explanations for those results.

Sugar-sweetened beverages intake

The risen prevalence of childhood obesity coincided with a dramatically increase in the consumption of sugar-sweetened beverages (SSBs) during childhood (Keller and Bucher Della Torre, 2015; Nelson et al., 2009; Scharf and DeBoer, 2016). SSBs include a wide variety of drink types such as carbonated sweet beverages, fruit drinks, hot/cold beverages with sugar, sodas, and soft drinks. Soft drinks consumption adds to soft drinks consumers 188kcal/day more to their energy intake compared to non-consumers (St-Onge et al., 2003). As evidenced from cross-sectional, longitudinal, interventional studies, and systematic reviews, there is a positive association between SSBs consumption and increased risk of obesity, or unhealthy weight gain in children (Bucher Della Torre et al., 2016; Malik et al., 2013). In a study conducted in school aged children with a mean age of 11.7 ± 0.8 years in public schools in Massachusetts communities, for every additional daily serving of sugar-sweetened drink consumed, children found to have 1,6 times greater risk of becoming obese (Ludwig et al., 2001). Similarly, the odds ratio for being overweight or obese was 1.55 (1.32 to 1.82) in children with a high SSBs' intake compared with those with low intake, after one year of follow-up in prospective studies (Morenga et al., 2013). Additionally, adolescents who increased the consumption of SSBs from the prior year experienced higher weight gain compared with those who did not (Berkey et al., 2004). High added sugar content, low satiety, and increased intake of «liquid» calories are the main contributors to weight gain through SSBs consumption.

Lack of physical activity

Another driver for the obesity epidemic is the reduced levels of physical activity as well as the increased time of sedentary behavior (Croezen et al., 2009; Sigmund et al., 2015; Swinburn et al., 2011; Townshend and Lake, 2017). Physical activity plays an essential role in children and adolescents' growth and development, as well as for the prevention of overweight and obesity and the reduction of health complications (Hills et al., 2011, 2007).

Recent reports suggested that life expectancy is likely to fall in today's generation of children as of lack of physical activity in one's early years (Hills et al., 2007). For children and adolescents aged 5-17 years old, in order to achieve benefits for physical, social, and mental health, it is recommended to take part in at least 60 minutes of moderate to vigorous physical activity (MVPA) per day (Janssen and LeBlanc, 2010). The more physical activity, the greater the health benefit (Hills et al., 2011; Janssen and LeBlanc, 2010). A pooled analysis of 298 population-based surveys with 1,6 million participants in 2016, found that more than 80% adolescents aged 11-17 years old, do not meet current physical activity guidelines (Guthold et al., 2020).

Additionally, the changes on the build environment and in their parents' work lives have resulted in less walking or biking and more car driving, with a substantial decrease in children's daily physical activity. Children that walk or bike to school nowadays are less than a quarter compared to few generations ago (Anderson and Butcher, 2006). Physical environment may play an important role into the physical activity and sedentary behaviors of children and adolescents. For 9- and 11-years old children living in rural areas, a higher physical activity and a less prevalent screen time behavior was reported compared to their counterparts in urban areas (Ng et al., 2019).

Sedentary behaviors

The use of devices such as television, tablets, phones, and computers during leisure time leads to decreased levels of physical activity, increased consumption of low-quality foods, and increased quantity of foods consumed (Kumar and Kelly, 2017; Lipsky and Iannotti, 2012). Television viewing has increased dramatically in recent years among school-aged children and adolescents. Obesity prevalence was found to increase by 2% with each additional hour of television per day (Anderson and Butcher, 2006). When television viewing is a routine while eating with family, eating pattern of children found to include less fruits and vegetables and more salty snacks, pizza, and sodas, in children from 8 to 11 years of age (Coon et al., 2001).

Consequences of Childhood obesity

Childhood obesity is associated with psychosocial problems, adverse health outcomes (Ebbeling et al., 2002) and persistence into adulthood (Guo et al., 2000; Roberts et al., 2012). The wide range of serious complications of excess weight in childhood, can occur both in the short-term and in the long-run (Di Cesare et al., 2019). This has raised concern on the impact of obesity epidemic on the current generation of children's life expectancy (*American Heart Association Childhood Obesity Research Summit Report | Circulation*, 2009).

Psychosocial consequences of Childhood Obesity

There is an established association between overweight and obesity in childhood, and detrimental effects on the psychosocial domain (Rankin et al., 2016). Overweight or obese children and adolescents are more likely to experience teasing and bullying (Hayden-Wade et al., 2005; Spinelli et al., 2019), as opposed to their normal-weight counterparts. This entails children with excess weight are on a higher risk of obesity stigmatization. Obesity stigma seriously impacts emotional and physical health (Rankin et al., 2016), weakens self-esteem, increases sadness and loneliness, and encourages high-risk behaviors (Ebbeling et al., 2002; Uzogara, 2017). Additionally, discrimination and social exclusion of overweight or obese children is also reported by health care providers (Ebbeling et al., 2002; Wilfley et al., 2010). Obese children tend to perform lower at school, and participate less in activities (Uzogara, 2017). Impaired academic performance in one due to school absenteeism, especially when children or adolescents suffer from chronic diseases such as asthma or diabetes (Sahoo et al., 2015).

Therefore, overweight or obese children and adolescents experience higher risk of developing psychological comorbidities including depression (Quek et al., 2017), anxiety, low self-esteem, and other behavioral disorders (Rankin et al., 2016). Negative self-image can be developed as early as five years old in overweight children (Davison and Birch, 2001). Body dissatisfaction and low self-esteem in overweight and obese children may trigger the onset of an eating disorder (ED) from young age, given that EDs start to develop well before the actual clinical diagnosis (Kevin, 2001; Lundstedt et al., 2006; Wilfley et al., 2010). All in all, these detrimental consequences in psychosocial aspect may result in diminished social well-being and overall reduced quality of life (Griffiths et al., 2010; Rankin et al., 2016; Sahoo et al., 2015; Wilfley et al., 2010).

Medical consequences of Childhood Obesity

Childhood obesity is also linked to numerous medical consequences. These health consequences may cause metabolic effects, involving the cardiovascular, endocrine, gastrointestinal and renal systems, and mechanical effects, involving the pulmonary, skeletal, and central nervous systems (Banerjee and Schuster, 2012). Increased BMI in childhood is associated with a higher incidence of chronic diseases such as type 2 diabetes, hypertension, fatty liver disease (Berardis and Sokal, 2014; Ranucci et al., 2017), cardiovascular disease, various forms of cancer, sleep problems such as sleep apnea (Redline et al., 1999) and musculoskeletal disorders in adulthood (“WHO | Overweight and obesity,” 2020).

Obese children found to have increased metabolic and cardiovascular risk factors such as insulin resistance and glucose intolerance, high blood pressure, dyslipidemia, and early markers of cardiovascular disease (CVD) (Di Cesare et al., 2019; “WHO | Overweight and obesity,” 2020). In fact, two-thirds of obese children have at least one CVD risk factor and over a third have two or more (Freedman et al., 2007). The increasing prevalence of overweight and obesity in children has been associated with the rising prevalence of MetS in early life. MetS is a cluster of conditions involving hypertension, hyperglycemia, dyslipidemia, and obesity with truncal fat and insulin resistance to be the main concerns (Banerjee and Schuster, 2012).

The risk of developing glucose intolerance increases with excess weight. Obesity adversely affects various associated alterations in the glucose/insulin axis and on lipid metabolism (Banerjee and Schuster, 2012). The prevalence of impaired glucose tolerance (glycated hemoglobin greater than 5,7 mg/dL) or fasting glucose greater than or equal to 100mg/dL was found to be 1,87% in overweight adolescents. A gradual increase to 13,19% was reported in adolescents with markedly severe obesity (class III obesity, BMI ≥ 40 kg/m^2)(Skinner et al., 2015). Hypertension, particularly higher systolic pressure, in children and adolescents was found to be associated with adiposity (Parker et al., 2016). Adolescents with class III obesity, had 2,5-7,6 times greater risk to develop high blood pressure, both systolic and diastolic, compared to those with class I obesity (≥30 BMI <35 kg/m^2), when controlling for sex, age, and race. Childhood obesity may also alter the lipidemic profile. Children and adolescents with markedly severe obesity found to have higher risk of low HDL cholesterol levels and high triglyceride levels, compared to those with class I obesity (Skinner et al., 2015).

Increased BMI in early life and during adolescence, is also associated with higher risk of developing several malignancies in adulthood, regardless of the timing of obesity. A large multiethnic study with 45 years follow-up period revealed an association between increased BMI during adolescence and higher risk for leukemia (Shamriz et al., 2017), Non-Hodgkin lymphoma (Leiba et al., 2016), gastroesophageal adenocarcinoma (Levi et al., 2013), pancreatic (Levi et al., 2012) , colorectal (Levi et al., 2011) and breast cancer, renal cell carcinoma (Leiba et al., 2013), and acute myeloid leukemia (Poynter et al., 2016) in adulthood (Weihrauch-Blüher et al., 2019).

Endocrine abnormalities, hyperandrogenism and excess adiposity as a result of increased BMI, are shown to impact the hypothalamus-hypophysis-gonadal axis and fertility in both genders (Davidson et al., 2015; Sanchez et al., 2018). Excess weight in males affect their testosterone levels and causes a chronic inflammatory state with increased formation of reactive oxygen species (ROS). ROS may harm the sperm DNA and membrane, and elevate stress on the testicular environment (Du Plessis et al., 2010; Sanchez et al., 2018). Young girls with increased BMI also experience menstrual abnormalities, and polycystic ovary syndrome in adult life (PCOS) (Anderson et al., 2014; Sahoo et al., 2015). In a longitudinal population-based study was found that obesity in 14-years old girls was associated with a 61% higher risk of having PCOS symptoms at the age of 31 (Laitinen et al., 2003). Infertility in women during adult life was also found to be associated with childhood obesity before their 12th birthday in a 25 year follow-up study (He et al., 2018). Obesity is associated not only with early onset of puberty in girls, but also with lower age at menarche (Currie et al., 2012; Li et al., 2017).

Excess weight is associated with increased incidence of pediatric asthma in overweight, and particularly, obese children which are at a higher risk of experiencing difficulties in breathing and developing asthma onset during childhood (Egan et al., 2013; Lang et al., 2018). Lower ability to exercise leads to the persistence and the progression of obesity and to a vicious cycle. Childhood and adolescent adiposity were found to be associated with increased risk of asthma in adulthood, thus increasing the need of chronic medication (Banerjee and Schuster, 2012).

Long term effects of Childhood Obesity

Obesity in childhood is associated with a higher risk of adulthood obesity, premature death (Must et al., 1992; Park et al., 2012), and disability in adult life ("WHO | Overweight and obesity," 2020). The excess of adiposity during childhood is one of the main factors that contributes to the persistence of obesity into adulthood, and to the onset of medical complications (Simmonds et al., 2016; Yanovski, 2015). Overweight or obese children had five times higher risk to carry this status in adult life, compared to normal-weight children

(Simmonds et al., 2016). It is striking that, 4 out of 5 obese adolescents will still be obese in adulthood, while 7 out of 10 will be obese over their thirties. This suggests that weight in puberty is a strong predictor of adult obesity (Di Cesare et al., 2019; Freedman et al., 2004; Simmonds et al., 2016).

Aim of this study

Based on the above, the aim of this study was to estimate the current prevalence of overweight and obesity in a nationally representative sample of school-aged adolescents living in Greece and to further explore its association with diet-related behaviours and habits with the ultimate goal of contibuting to the development of evidence-based recommendations for the prevention and management of overweight and obesity in this age group.

Materials and Methods

Study Participants

Data for present analyses were collected using standardized protocols for the 2018 Greek arm of the HBSC study, conducted by the University Mental Health, Neurosciences and Precision Medicine Research Institute quadrennially since 1998. The HBSC study is a WHO multinational survey aimed to increase our knowledge into health and health behaviors of school children (Currie et al., 2009). In Greece, the study received ethical approval from the Ministry of Education. A nationally representative sample of 11, 13, and 15-year old students was selected using a multistage stratified random cluster sampling procedure with the school class as the sampling unit was employed. Stratification was based on a) administrative region (NUTS II in the European Union's classification) (10 out of 13 Greece's regions, excluding the Ionian and North and South Aegean islands for logistical reasons), and b) school type (comprehensive/technical/private) (Benetou et al., 2020). Parental consent was required according to the study's protocol, and students' participation was voluntary and anonymous. Questionnaires were administered in class by trained assistants during two consecutive regular class periods. Data were collected from 238 schools. For the present analyses 8% of the filled-in-student questionnaires were excluded due to a high proportion of missing values or for being out of the age limits imposed by HBSC survey methodology. The final number of students was 3863 (1927 boys and 1936 girls).

Data on anthropometry

Body weight (in kilograms) and height (in centimeters) without clothes and shoes, were based on self-reports. Body Mass Index was calculated as the ratio of weight divided by the square of height (kg/m^2). Z-scores were then calculated and overweight and obesity were defined using age- and gender-specific cut-offs recommended by the WHO growth charts (WHO) (de Onis et al., 2007). Overweight is defined as more than 1SD above the median to 2SD above the median (equivalent to BMI 25 kg/m^2 at 19 years), and obesity as more than 2SD above the median (equivalent to BMI 30 kg/m^2 at 19 years)(de Onis et al., 2007).

Diet related behaviours and food consumption

Information related to diet-related behaviours and consumption of selected food groups and beverages were collected through standardised questionnaires. Diet-related behavioural data was collected on the frequency of: a) breakfast consumption on weekdays, b) eating snacks while watching TV or video, c) eating snacks while sitting in front of a screen for homework or games, d) eating meals while watching TV, e) eating in fast-food restaurants and f) eating meals with their family. To assess regular breakfast consumption students were asked to estimate on how many days during the week they had breakfast (defined as having more than ona glass of milk or fruit juice), with responses from ”never” to ”all five days”. Subjects were further grouped according to their response into fewer categories: “never”, “1-4 days”, “always (5 days)” for eatimg breakfast. The possible responses for the questions on eating meals/snacks in front of TV/screen were six, ranging from ”never” to ”every day”. For the three behaviours related to eating snacks/meals in front of TV/screens (b-d) we further developed a combined score for eating ranging from 0-6. The higher the score, the higher the frequency of eating in front of TV/screens. To determine the frequency of eating in fast-food restaurants the available responses were seven, ranging from “never” to ”five or more days/week”, and five with respect to family meals, ranging from ”every day” to ”never”. Subjects were further grouped according to their response into fewer categories: “never”, “less than once/month”, “1-3 days/month”, “weekly” for eating in fast-food restaurants, and “every day”, “almost every day”, “rarely” for family meals.

Students’ weight-reduction behaviour measuring their attempts to lose weight was also recorded. The possible answers were “No, my weight is fine”, ”No, but I should lose some weight”, ”No, because I need to put on weight”, and ”Yes”. A dichotomous variable was further created to classify students according to whether or not they were on a diet ”No” / ”Yes”.

In relation to food consumption, students were asked to report their frequency of consumption during a typical week of the year for the following food groups and beverages: a) fruits, b) vegetables/salads, c) sweets (candies, chocolates), d) non-diet soft drinks and sugar-sweetened beverages. The possible responses for each group were seven and ranged from ”never” to “more than once a day”. Subjects were further grouped according to their response into fewer categories: “less than once/week”, “1-4 days/week”, “5-6 days/week”, “every day” for fruit, vegetable, sweet consumption, and “less than once/week”, “1-4 days/week”, “>5 days/week” for non-diet soft drinks and sugar-sweetened beverages intake. Information related to food consumption of selected food groups and beverages and diet-related behaviors were collected through standardized questionnaires. More specifically, students were asked to report their frequency of consumption during a typical week of the year for the following food groups and beverages: a) fruits, b) vegetables/salads, c) sweets (candies, chocolates), d) non-diet soft drinks and sugar-sweetened beverages, e) coffee and

f) energy drinks (the last two being national items). The possible responses were seven and ranged from «never» to «more than once a day».

In relation to diet-related behaviors data on the frequency of a) breakfast consumption on weekdays, b) eating snacks while watching TV or video, c) eating snacks while sitting in front of a screen for homework or games, d) eating meals while watching TV, e) eating in fast-food restaurants and f) eating meals with their family, was collected. To assess regular breakfast consumption students were asked to estimate how many days during the week they had breakfast (defined as having more than a glass of milk or fruit juice), with responses from «never» to «all five days». The possible responses for the questions eating meals/snacks in front of TV/screen were six ranging from «never» to «every day».

Other Variables

Students were asked to report their gender, month, and year of birth. School-level data was also collected on the area where the schools were located. Age groups, age in months, and in years were computed. A family affluence scale (FAS) score was calculated using a six-item assessment of common material assets or activities. Responses were scored and summed to form an HBSC FAS summary score, which was then categorized into groups of young people in the lowest 20% (low affluence), middle 60% (medium affluence), and highest 20% (high affluence) (Inchley et al., 2020). Physical activity was assessed by asking students to report the number of days over the past week during which they were physically active for a total of at least 60 minutes. Physical activity was defined as ”any activity that increases your heart rate and makes you get out of breath some of the time”, with examples of such activities. Subjects were further grouped according to these response into fewer categories: “0-1 days”, “2-3 days”, “4-5 days”, “6-7 days”.

Missing values

Following an investigation of the extent of missing data on all variables included in the analysis, **(Appendix 1),** 4.6% missing values concerned BMI. Data are missing at random

(MAR) when the probability that data are missing depends on the observed data (Sterne et al., 2009). Multiple imputation is generally used if that assumption holds, as it provides a flexible and transparent means of imputing missing data (Sterne et al., 2009). We conducted multiple imputation by age category (11-, 13-, and 15-year-olds), and we created multiple copies of datasets (n=10) with imputed values. Imputation was stratified by region (18 clusters). We then calculated the BMI, the z-scores, and the BMI category. A flowchart depicting missing values in each variable and the final number of participants after the imputation process, as well as a similar flowchart with complete data are shown **in Appendix 1**. The final sample of the study after the imputation was 3.816 adolescents, 1898 (49.7%) boys and 1.918 (50.3%) girls.

Statistical analysis

Participants' data were summarized by frequencies and percentages for categorical variables, and by mean and standard deviation for continuous variables. The χ^2 test was used to compare differences between boys and girls, and the t-test to identify differences for continuous parameters. Prevalence of non-overweight (normal weight including underweight), overweight, and obesity was estimated in the imputed data sample (n=3.816) as well as in the complete data sample (n=3.366). Odds ratios (OR) and 95% confidence intervals (CI) derived from logistic regression models assessing the association between overweight status (overweight vs non-overweight) diet-related behaviours and food frequency intake were estimated. The overweight category included both overweight and obese students.

A total of three models were used, the crude model (Model 1), a model where all variables entered in the model simultaneously adjusting for sex, age category, physical activity and family affluence score (Model 2), and the fully adjusted model, where in the Model 2 was additionally added the variable dieting (Model 3). We chose to construct this third model in order to be able to assess separately the influence of being on a diet or implementing any other weight reduction behaviour on the associations under study.

The significance level was defined at $p<0.05$. Multicollinearity was assessed using the variance inflation factor (VIF) and no problem was detected (overall VIF = 1.11). All analyses took into account for the survey design -i.e. geographical stratified sampling by regions (Nuts II) and cluster effect for school classes- via the svy commands of Stata. Analyses were performed using STATA 13.1 (STATA Corporation, College Station, TX, USA).

Results

From the initial sample of 3863 school-aged adolescents, 15 were excluded due to unknown/missing values related to the place of birth and 32 were excluded due to missing values in age category **(Appendix 1: Flowchart)**. Thus, the final sample of this study consisted of 3816 school-aged adolescents, 1898 (49.7%) boys and 1918 (50.3%) girls, aged 11-, 13-, and 15-year-old. The great majority were born in Greece (96.3%) while half of them were residing in two prefectures of Greece where the largest cities are situated, 37.4% in Attica (where the capital of Greece, Athens is situated) and 14.6% in Thessaloniki (where the city of Thessaloniki is situated). Participants were evenly distributed across predefined age groups and grade at school by design**(Table 2).**

Table 2: Sociodemographic characteristics of 3816 participants in the 2018 Greek arm of the HBSC* study

Gender, n (%)	
Boys	1898 (49.7%)
Girls	1918 (50.3%)
Age Group, n (%)	
11-years-old	1216 (31.9%)
13-years-old	1299 (34.0%)
15-years-old	1301 (34.1%)
Region/municipality, n (%)	
Attica	1427 (37.4%)
Thessaloniki	557 (14.6%)
Other	1832 (48.0%)
Place of birth, n (%)	
Greece	3675 (96.3%)
Other	141 (3.7%)
Grade, n (%)	
6^{th}	1241 (32.5%)
8^{th}	1307 (34.3%)
10^{th}	1268 (33.2%)

Family Affluence scale (FAS) score [a], n(%)	
Low 20% affluence	545 (14.6%)
Middle 60% affluence	2392 (64.0%)
High 20% affluence	803 (21.4%)

[a]: Quantiles were calculated based on FAS score distribution of FAS score by gender and age group
** HBSC: Health Behavior in School-aged Children study*

Diet-related behaviors and dieting

In Table 3, the diet-related behaviors and dieting as well as, physical activity during the past 7 days of study participants, are presented for the available data for the total sample and by gender. Overall, 48.0% reported having daily breakfast consumption during weekdays with statistically significant difference between gender (p<0.001), with boys eating breakfast more regularly than girls (51.4% boys vs 44.6% girls reported daily consumption). The frequency of having family meals differed significantly by gender with boys eating every day with their family more often compared to girls (51.4% vs 44.6%).

One out of five adolescents (22.0%) reported eating a snack while watching TV five or more days per week, with no statistically significant difference between genders (p=0.22). One third of the total sample (32.3%) reported eating snacks in front of PC/tablet/laptop almost every day, with boys reporting this behavior more often than girls (38.4% vs 26.4%, p<0.001). Watching TV while eating meal five or more days per week was reported by 26.1% of the adolescents, with no statistically significant difference between gender (p=0.065). Eating in fast food restaurants on a weekly basis was reported by almost 1 out of 4 adolescents (23.9%), with more boys than girls to report eating fast food so frequently (26.9% vs 20.8%, p<0.001). One in five adolescents (20.3%) reported being on a diet or anything else to lose weight, with a statistically significant higher percentage of girls to be in a weight loss attempt/pattern compared to boys (24.7 vs 15.8%, p<0.001). A greater proportion of adolescents reported being physically active 4 or 5 days in the past seven days (31.4%). Boys reported higher physical activity compared to girls as increased proportion was physically active 6 or 7 days in the past week (33.3 vs 21.5, p=<0.001).

Frequency of food and beverage intake

With respect to food and beverage intake nearly one third of students reported daily intake of fruit (31.1%) and vegetables (33.34%), with boys consuming fruits and vegetables every day significantly less than girls (29.6 vs 32.7%. p=0.034 and 29.9 vs 36.9%, p<0.001). Daily intake of sweets was more common in girls (16.6%) as compared to boys (14.4%) (p<0.001). In contrast, boys were significantly more frequent consumers of soft drinks or sugar sweetened beverages, compared to girls (p<0.001). A sugar-sweetened beverage consumption of five or more days per week was reported by 10.7% of the adolescents. Boys reported a high consumption (>5 days/week) of sugar-sweetened beverages more often than girls (12.7% vs 8.7%, p<0.001) **Table 4**.

Table 3 Describes diet-related behaviors, dieting, and physical activity levels among 3816* participants in the 2018 Greek arm of the HBSC study in the total sample and by gender

Variables		All ages	
	Total n (%)	**Boys** n (%)	**Girls** n (%)
Eating breakfast on weekdays (85 missing values)	**p<0.001**		
Never	1054 (28.2)	496 (26.9)	558 (29.6)
1-4 days	888 (23.8)	400 (21.7)	488 (25.8)
Always (5 days)	1789 (48.0)	946 (51.4)	843 (44.6)
Family meals (40 missing values)	**p<0.001**		
Every day	1793 (47.5)	963 (51.7)	830 (43.4)
Almost every day	1221 (32.3)	559 (30.0)	662 (34.6)
Rarely	762 (20.2)	342 (18.3)	420 (22.0)
Eating snacks while watching TV (17 missing values)	p=0.22		
Never	453 (11.9)	239 (12.7)	214 (11.2)
<1 days/week	851 (22.4)	402 (21.3)	449 (23.5)
1-4 days/week	1660 (43.7)	820 (43.4)	840 (43.9)
>=5 days/w	835 (22.0)	426 (22.6)	409 (21.4)
Eating snacks in front of PC/tablet/laptop (38 missing values)	**p<0.001**		
Never	687 (18.2)	268 (14.3)	419 (22.0)
<1 days/week	599 (15.9)	251 (13.3)	348 (18.3)
1-4 days/week	1270 (33.6)	638 (34.0)	632 (33.3)
>=5 days/w	1222 (32.3)	721 (38.4)	501 (26.4)
Eating meals while watching TV (13 missing values)	p=0.065		
Never	652 (17.1)	329 (17.4)	323 (16.9)
<1 days/week	735 (19.3)	332 (17.5)	403 (21.0)
1-4 days/week	1425 (37.5)	723 (38.3)	702 (36.6)
>=5 days/w	991 (26.1)	503 (26.7)	488 (25.5)
Eating in fast-food restaurants (2 missing values)	**p<0.001**		
Never	219 (5.7)	117 (6.2)	102 (5.3)
Less than once/month	1079 (28.3)	514 (27.1)	565 (29.5)
1-3 days/month	1606 (42.1)	755 (39.8)	851 (44.4)
Weekly	910 (23.9)	510 (26.9)	400 (20.8)
Diet or other patterns to lose weight (28 missing values)	**p<0.001**		
No	3019 (79.7)	1580 (84.2)	1439 (75.3)
Yes	769 (20.3)	298 (15.8)	471 (24.7)
Physical activity in the past 7 days (38 missing values)	**p<0.001**		
0-1 days	440 (11.6)	193 (10.3)	247 (12.9)
2-3 days	1120 (29.7)	458 (24.5)	662 (34.7)
4-5 days	1185 (31.4)	595 (31.9)	590 (30.9)

6-7 days	1033 (27.3)	622 (33.3)	411 (21.5)
Family Affluence scale (FAS) score (76 missing values)	**p=0.335**		
Low	545 (14.6)	271 (14.6)	274 (14.6)
Medium	2392(64.0)	1170 (63.0)	1222 (64.9)
High	803 (21.4)	417 (22.4)	386 (20.5)

** from complete case analysis n=3816.*

Table 4: Describes food and beverage intake among 3816 participants in the 2018 Greek arm of the HBSC study in the total sample and by gender

Food/Beverage intake		All ages	
	Total n (%)	**Boys** n (%)	**Girls** n (%)
Fruits (10 missing values)	**p=0.034**		
Less than once/week	322 (8.5)	162 (8.6)	160 (8.3)
1-4 days/week	1692 (44.5)	837 (44.3)	855 (44.6)
5-6 days/week	608 (15.9)	331 (17.5)	277 (14.4)
Every day	1184 (31.1)	558 (29.6)	626 (32.7)
Vegetables (15 missing values)	**p<0.001**		
Less than once/week	387 (10.2)	225 (11.9)	162 (8.4)
1-4 days/week	1361 (35.8)	710 (37.6)	651 (34.0)
5-6 days/week	784 (20.6)	388 (20.6)	396 (20.7)
Every day	1269 (33.4)	563 (29.9)	706 (36.9)
Sweets (16 missing values)	**p<0.001**		
Less than once/week	646 (17.0)	372 (19.8)	274 (14.3)
1-4 days/week	2072 (54.5)	983 (52.2)	1089 (56.8)
5-6 days/week	492 (13.0)	257 (13.6)	235 (12.3)
Every day	590 (15.5)	272 (14.4)	318 (16.6)
Sugar-sweetened beverage (6 missing values)			
Less than once/week	**p<0.001**		
1-4 days/week	1832 (48.1)	761 (40.2)	1071 (55.8)
>5 days/week	1572 (41.2)	891 (47.1)	681 (35.5)
	406 (10.7)	240 (12.7)	166 (8.7)

** from complete case analysis n=3816.*

Prevalence of overweight and obesity

Table 5 presents the percentages of non-overweight, overweight, and obese among the 3.816 adolescents based on the WHO growth charts classification.

In the total sample, prevalence of overweight was 19.4%; 24.1% among boys and 14.7% among girls, whereas prevalence of obesity was 5.3%; 7.3% among boys and 3.4% among girls. In the complete data sample (n=3366) prevalence of overweight was 19.2%; 24.2% among boys and 14.6% among girls, whereas prevalence of obesity was 5.2% in the total sample, 6.9% among boys and 3.6% among girls. The relevant percentages for the complete and the imputed data are presented in **Appendix 3,** were we observed that the prevalence rates were practically the same.

Table 5. Prevalence of Overweight and Obesity by gender and age category from imputed analysis (n=3816) in the 2018 Greek armof the HBSC study.

	UNDERWEIGHT	NORMALWEIGHT	OVERWEIGHT	OBESE
ALL AGES (n=3816)				
Total	**3.5%**	**71.8%**	**19.4%**	**5.3%**
Boys	3.2%	65.4%	24.1%	7.3%
Girls	3.7%	78.2%	14.7%	3.4%
11-YEAR-OLDS (n=1216)				
Total	**5.0%**	**67.7%**	**21.6%**	**5.7%**
Boys	3.7%	63.0%	26.1%	7.2%
Girls	6.4%	72.3%	17.1%	4.2%
13-YEAR-OLDS (n=1299)				
Total	**3.9%**	**71.3%**	**19.9%**	**4.9%**
Boys	4.2%	66.2%	23.0%	6.6%
Girls	3.5%	76.3%	16.8%	3.4%
15-YEAR-OLDS (n=1301)				
Total	**1.6%**	**76.1%**	**16.9%**	**5.4%**
Boys	1.8%	66.7%	23.4%	8.1%
Girls	1.4%	85.6%	10.4%	2.6%

*Abbreviations: HBSC study: Health Behaviour in School-Aged Children study, *Based on imputed data,* ***Underweight: <-2SD, Overweight: >+1SD, Obesity: >+2SD as per WHO growth charts.***

Univariable and multivariable logistic regression

For the following statistical analysis overweight youth included those who were obese, therefore students were categorized as non-Overweight and Overweight.

Table 6 shows results from the unadjusted (Model 1) and adjusted models (Models 2-4) exploring the association between overweight, diet-related behaviours and frequency of food consumption in both sexes. **Tables 7 and 8** present results from the same analyses separately among boys and girls, respectively.

Skipping breakfast was positively associated with being overweight in the total sample and among girls in the fully adjusted model. More specifically, those who never consumed breakfast on weekdays had 30% higher odds of being overweight compared to their counterparts who always ate breakfast (OR:1.30, 95%CI: 1.07-1.57) **(Table 6)**.

Eating rarely with the family was associated with being overweight in the total sample (OR:1.34, 95%CI: 1.07-1.67, in Model 2) and among boys (OR: 1.50, 95%CI: 1.14-1.97, in Model 2), but the association remained significant only among boys after controlling for dieting (Model 3) **(Tables 6,7,8)**.

A positive statistically significant association was found between the combined score of eating snacks/meals in front of screens and being overweight among girls. More specifically, one unit increase in the total score was associated with 12% higher odds of being overweight in the fully adjusted model (OR: 1.12, 95%CI: 1.03-1.22) **(Table 8)**. No statistically significant association was found in the total population and among boys.

No association was evident between frequency of eating in fast food restaurants and overweight in the total sample and by gender **(Tables 6,7,8)**.

Regarding intake of selected food and beverages, eating fruits less than 5 days per week compared to every day increased the odds of being overweight among boys (OR:1.52, 95%CI: 1.03-2.26) in the crude model but the association was no longer significant after controlling for age, sex, family affluence score and physical activity **(Table 7)**. No association was evident between the frequency of vegetable intake and overweight in the total sample and by gender **(Tables 6,7,8).** Eating sweets every day compared to eating sweets less than once per week was associated with being overweight in the total sample (OR:0.69, 95%CI: 0.51-0.94) and among boys (OR:0.67, 95%CI: 0.46-0.99) in Model 2, which was no longer evident in Model 3 **(Table 6)**. With respect to sugar-sweetened beverages, a moderate consumption (1-4 days per week) in comparison to consumption of less than once per week (OR:1.20, 95%CI: 1.03-1.41) was associated with 20% higher odds of being overweight in the crude model **(Table 6)**. However, associations did not remain significant in the fully adjusted model.

Being on a diet or something else to lose weight was strongly and significantly positively associated with a 4-fold increase in odds of being overweight in the total sample (OR:4.47, 95%CI: 3.68-5.43), among boys (OR:4.32, 95%CI: 3.25-5.74), and among girls (OR:5.39, 95%CI: 4.00-7.25) after adjusting for all other variables **(Tables 6,7,8)**.

Girls had 65% lower odds of being overweight compared to boys in the fully adjusted model (OR: 0.35, 95%CI: 0.29-0.42). Being overweight was negatively associated with age in the total sample and among girls, where 13-years-old and 15-years-old had lower odds of being overweight compared to 11-years-old in the fully adjusted model **(Tables 6,8)**. Lastly, increased frequency of moderate to vigorous physical activity reported for the last 7 days was strongly and inversely associated with being overweight.

Table 6. Odds ratios (OR) and associated 95% confidence intervals (CI) from logistic regression models exploring the association of Overweight with diet-related behaviours and habits among 3816 participants in the 2018 Greek arm of the HBSC study*

			Model 1		Model 2		Model 3	
Variables	**Non-Overweight n (%) /mean±sd**	**Overweight-Obese n (%) /mean±sd**	**OR (95% CI)**	**p-value**	**aOR[a] (95% CI)**	**p-value**	**aOR[b] (95% CI)**	**p-value**
Eating breakfast on weekdays								
Never	768 (71.2)	311 (28.8)	**1.35 (1.14-1.59)**	**0.001**	**1.31 (1.08-1.57)**	**0.005**	**1.30 (1.07-1.57)**	**0.007**
1-4 days	693 (76.4)	214 (23.6)	1.06 (0.87-1.28)	0.565	1.09 (0.89-1.33)	0.417	1.04 (0.85-1.28)	0.701
Always (5 days)	1409 (77.0)	421 (23.0)	**Ref.**		**Ref.**		**Ref.**	
Family meals								
Every day	1365 (75.2)	451 (24.8)	**Ref.**		**Ref.**		**Ref.**	
Almost every day	949 (77.1)	281 (22.9)	0.90 (0.76-1.08)	0.257	1.02 (0.85-1.22)	0.807	0.97 (0.81-1.17)	0.765
Rarely	556 (72.2)	214 (27.8)	1.19 (0.96-1.48)	0.113	**1.34 (1.07-1.67)**	**0.011**	1.22 (0.96-1.54)	0.098
Total score for behaviour of eating snacks/meals in front of screens (TV/PC/tablet)	2.73 ± 1.7	2.81 ± 1.6	1.04 (0.99-1.10)	0.103	1.02 (0.97-1.08)	0.422	1.02 (0.96-1.08)	0.469
Eating in fast-food restaurants								
Never	166 (75.8)	53 (24.2)	**Ref.**		**Ref.**		**Ref.**	
Less than once/month	786 (72.8)	294 (27.2)	1.14 (0.82-1.60)	0.430	1.25 (0.87-1.80)	0.225	1.29 (0.87-1.89)	0.203
1-3 days/month	1223 (76.1)	383 (23.9)	0.96 (0.69-1.35)	0.831	1.08 (0.75-1.56)	0.690	1.07 (0.72-1.59)	0.751
Weekly	695 (76.3)	216 (23.7)	0.96 (0.67-1.37)	0.826	1.04 (0.69-1.55)	0.861	1.02 (0.67-1.57)	0.918
Fruits intake								
Less than once/week	233 (71.9)	91 (28.1)	1.31 (0.96-1.78)	0.088	1.05 (0.75-1.46)	0.793	1.17 (0.83-1.65)	0.356
1-4 days/week	1260 (74.2)	438 (25.8)	1.16 (0.98-1.37)	0.075	1.05 (0.86-1.27)	0.651	1.09 (0.89-1.33)	0.413
5-6 days/week	466 (76.6)	142 (23.4)	1.00 (0.81-1.24)	0.987	0.93 (0.74-1.16)	0.522	0.93 (0.74-1.18)	0.564
Every day	911 (76.8)	275 (23.3)	**Ref.**		**Ref.**		**Ref.**	
Vegetables intake								
Less than once/week	283 (72.8)	106 (27.2)	1.23 (0.95-1.59)	0.110	0.92 (0.70-1.22)	0.576	0.92 (0.69-1.22)	0.554
1-4 days/week	1017 (74.4)	350 (25.6)	1.09 (0.90-1.31)	0.364	0.92 (0.75-1.12)	0.407	0.98 (0.80-1.21)	0.846
5-6 days/week	601 (76.4)	186 (23.6)	0.97 (0.79-1.20)	0.810	0.90 (0.73-1.12)	0.354	0.96 (0.77-1.19)	0.681
Every day	969 (76.1)	304 (23.9)	**Ref.**		**Ref.**		**Ref.**	**Ref.**

Sweets intake								
Less than once/week	474 (73.0)	175 (23.0)	**Ref.**		Ref.		Ref.	
1-4 days/week	1555 (74.8)	525 (25.2)	0.89 (0.73-1.08)	0.245	0.98 (0.79-1.21)	0.826	1.02 (0.81-1.28)	0.873
5-6 days/week	372 (75.4)	121(24.6)	0.86 (0.66-1.12)	0.270	0.92 (0.68-1.24)	0.580	1.12 (0.82-1.54)	0.473
Every day	469 (79.0)	125 (21.0)	**0.68 (0.52-0.90)**	**0.008**	**0.69 (0.51-0.94)**	**0.017**	0.84 (0.60-1.18)	0.312
Sugar-sweetened beverage intake								
Less than once/week	1417 (77.3)	417 (22.7)	**Ref.**		**Ref.**		**Ref.**	
1-4 days/week	1158 (73.5)	418 (26.5)	**1.20 (1.03-1.41)**	**0.022**	1.09 (0.91-1.29)	0.345	1.08 (0.90-1.29)	0.416
>5 days/week	295 (72.7)	111 (27.3)	1.29 (0.98-1.70)	0.071	1.17 (0.86-1.60)	0.323	1.18 (0.86-1.62)	0.316
Being on a diet or doing something else to lose weight								
No	2442 (80.3)	599 (19.7)	**Ref.**				**Ref.**	**<0.001**
Yes	428 (55.2)	347 (44.8)	**3.33 (2.77-4.00)**	**<0.001**			**4.47 (3.68-5.43)**	
Gender								
Boys	1303 (68.7)	595 (31.3)	**Ref.**		**Ref.**		**Ref.**	
Girls	1567 (81.7)	351 (18.3)	**0.48 (0.41-0. 57)**	**<0.001**	**0.43 (0.36-0.51)**	**<0.001**	**0.35 (0.29-0.42)**	**<0.001**
Age group								
11-year-olds	879 (72.3)	337 (27.7)	**Ref.**		**Ref.**		**Ref.**	
13-year-olds	980 (75.4)	319 (24.6)	0.88 (0.73-1.06)	0.186	0.84 (0.68-1.02)	0.075	**0.78 (0.63-0.97)**	**0.024**
15-year-olds	1011 (77.7)	290 (22.3)	**0.76 (0.62-0.94)**	**0.009**	**0.69 (0.57-0.85)**	**<0.001**	**0.62 (0.50-0.77)**	**<0.001**
Family Affluence Scale (FAS)								
Low 20% affluence	369 (66.4)	187 (33.6)	**Ref.**		**Ref.**		**Ref.**	
Middle 60% affluence	1858 (76.2)	580 (23.8)	**0.61 (0.50-0.75)**	**<0.001**	**0.64 (0.51-0.79)**	**<0.001**	**0.61 (0.48-0.77)**	**<0.001**
High 20% affluence	643 (78.2)	179 (21.8)	**0.55 (0.42-0.71)**	**<0.001**	**0.59 (0.45-0.78)**	**<0.001**	**0.57 (0.43-0.76)**	**<0.001**
Physical activity (past 7 days)								
0-1 days	304 (68.5)	140 (31.5)	**1.83 (1.40-2.38)**	**<0.001**	**2.12 (1.61-2.81)**	**<0.001**	**2.53 (1.88-3.40)**	**<0.001**
2-3 days	810 (71.9)	317 (28.1)	**1.59 (1.29-1.97)**	**<0.001**	**1.89 (1.51-2.35)**	**<0.001**	**1.98 (1.58-2.49)**	**<0.001**
4-5 days	917 (76.7)	278 (23.3)	1.24 (0.99-1.54)	0.057	**1.33 (1.06-1.67)**	**0.014**	**1.37 (1.08-1.73)**	**0.010**
6-7 days	839 (79.9)	211 (20.1)	**Ref.**		**Ref.**		**Ref.**	

*Abbreviations: HBSC study: Health Behaviour in School-Aged Children study, aOR: adjusted odds ratio, CI: Confidence interval. *Based on imputed data*
***Model 1**:unadjusted, **Model 2:** included all diet-related behaviours and dietary variables simultaneously adjusted for sociodemographic variables (sex,age category, family affluence score FAS), and physical activity (aOR[a]) **Model 3:** Model 2 included the variable dieting (aOR[b]).*

Table 7. Odds ratios (OR) and associated 95% confidence intervals (CI) from logistic regression models exploring the association of Overweight with diet-related behaviours and habits among 1898 school-aged boys participants in the 2018 Greek arm of the HBSC study.

			Model 1		Model 2		Model 3	
Variables	**Non-Overweight n (%) /mean (sd)**	**Overweight-Obese n (%) /mean (sd)**	**OR (95% CI)**	**p-value**	**aOR[a] (95% CI)**	**p-value**	**aOR[b] (95% CI)**	**p-value**
Eating breakfast on weekdays								
Never	321 (62.9)	189 (37.1)	**1.38 (1.09-1.76)**	**0.008**	1.24 (0.95-1.61)	0.112	1.22 (0.93-1.59)	0.150
1-4 days	295 (71.1)	120 (28.9)	1.01 (0.78-1.30)	0.960	0.98 (0.75-1.27)	0.864	0.94 (0.72-1.23)	0.639
Always (5 days)	687 (70.6)	286 (29.4)	**Ref.**		**Ref.**		**Ref.**	
Family meals								
Every day	686 (69.8)	297 (30.2)	**Ref.**		**Ref.**		**Ref.**	
Almost every day	402 (70.9)	165 (29.1)	0.97 (0.77-1.22)	0.807	1.05 (0.83-1.33)	0.687	1.02 (0.80-1.30)	0.884
Rarely	215 (61.8)	133 (38.2)	**1.49 (1.14-1.96)**	**0.004**	**1.54 (1.16-2.04)**	**0.003**	**1.42 (1.05-1.91)**	**0.023**
Total score for behaviour of Eating snacks/meals in front of screens (TV/PC/tablet)	2.95 ± 1.65	2.81 ± 1.58	0.96 (0.90-1.03)	0.224	0.97 (0.90-1.04)	0.341	0.96 (0.89-1.03)	0.276
Eating in fast-food restaurants								
Never	82 (70.1)	35 (29.9)	**Ref.**		**Ref.**		**Ref.**	
Less than once/month	341 (66.2)	174 (33.8)	1.18 (0.75-1.86)	0.464	1.30 (0.80-2.11)	0.283	1.44 (0.87-2.39)	0.158
1-3 days/month	517 (68.5)	238 (31.5)	1.08 (0.69-1.67)	0.748	1.26 (0.77-2.05)	0.355	1.35 (0.81-2.25)	0.240
Weekly	363 (71.0)	148 (29.0)	0.96 (0.60-1.54)	0.871	1.14 (0.67-1.94)	0.628	1.23 (0.71-2.13)	0.457
Fruits intake								
Less than once/week	97 (59.1)	67 (40.9)	**1.52 (1.03-2.26)**	**0.035**	1.28 (0.80-2.03)	0.298	1.48 (0.93-2.35)	0.096
1-4 days/week	577 (68.5)	266 (31.5)	1.03 (0.81-1.30)	0.834	0.98 (0.75-1.29)	0.898	1.02 (0.77-1.35)	0.900
5-6 days/week	247 (74.6)	84 (25.4)	**0.75 (0.57-0.99)**	**0.049**	0.77 (0.57-1.04)	0.087	0.76 (0.56-1.05)	0.091
Every day	382 (68.2)	178 (31.8)	**Ref.**		**Ref.**		**Ref.**	
Vegetables intake								
Less than once/week	150 (66.1)	77 (33.9)	1.05 (0.75-1.46)	0.795	0.83 (0.56-1.21)	0.331	0.81 (0.55-1.20)	0.303
1-4 days/week	496 (69.5)	218 (30.5)	0.90 (0.71-1.15)	0.397	0.82 (0.63-1.08)	0.155	0.83 (0.62-1.10)	0.185
5-6 days/week	279 (71.4)	112 (28.6)	0.80 (0.61-1.04)	0.098	0.77 (0.58-1.02)	0.066	0.81 (0.61-1.08)	0.147
Every day	378 (66.8)	188 (33.2)	**Ref.**		**Ref.**		**Ref.**	

Sweets intake								
Less than once/week	248 (66.1)	127 (33.9)	**Ref.**		**Ref.**		**Ref.**	
1-4 days/week	672 (68.0)	317 (32.0)	0.92 (0.72-1.17)	0.476	0.95 (0.73-1.24)	0.694	0.99 (0.75-1.31)	0.945
5-6 days/week	184 (71.3)	74 (28.7)	0.78 (0.56-1.09)	0.149	0.83 (0.57-1.19)	0.300	0.98 (0.67-1.45)	0.933
Every day	199 (72.1)	77 (27.9)	0.72 (0.51-1.02)	0.068	**0.67 (0.46-0.99)**	**0.046**	0.77 (0.50-1.17)	0.221
Sugar-sweetened beverage intake								
Less than once/week								
1-4 days/week	523 (68.5)	240 (31.5)	**Ref.**		**Ref.**		**Ref.**	
>5 days/week	620 (69.3)	275 (30.7)	0.95 (0.77-1.18)	0.650	0.98 (0.78-1.23)	0.851	0.96 (0.76-1.21)	0.723
	160 (66.7)	80 (33.3)	1.08 (0.77-1.51)	0.648	1.19 (0.81-1.76)	0.374	1.18 (0.79-1.75)	0.423
Being on a diet or doing something else to lose weight								
No	1181 (74.0)	416 (26.0)	**Ref.**				**Ref.**	
Yes	122 (40.5)	179 (59.5)	**4.18 (3.18-5.48)**	**<0.001**			**4.32 (3.25-5.74)**	**<0.001**
Age group								
11-year-olds	399 (66.2)	204 (33.8)	**Ref.**		**Ref.**		**Ref.**	
13-year-olds	455 (70.8)	188 (29.2)	0.84 (0.65-1.08)	0.170	0.83 (0.64-1.09)	0.186	0.85 (0.63-1.13)	0.255
15-year-olds	449 (68.9)	203 (31.3)	0.92 (0.69-1.21)	0.549	0.86 (0.64-1.16)	0.337	0.86 (0.63-1.18)	0.356
Family Affluence scale (FAS)								
Low 20% affluence	172 (61.9)	106(38.1) 364	**Ref.**		**Ref.**		**Ref.**	
Middle 60% affluence	829 (69.5)	(30.5)	**0.70 (0.54-0.92)**	**0.011**	0.75 (0.56-1.01)	0.054	**0.72 (0.54-0.98)**	**0.037**
High 20% affluence	302 (70.7)	125 (29.3)	**0.67 (0.49-0.91)**	**0.012**	0.77 (0.55-1.08)	0.129	0.78 (0.55-1.11)	0.168
Physical activity (past 7 days)								
0-1 days	114 (57.9)	83 (42.1)	**2.21 (1.59-3.05)**	**<0.001**	**2.08 (1.47-2.94)**	**<0.001**	**2.20 (1.53-3.16)**	**<0.001**
2-3 days	280 (60.5)	183 (39.5)	**2.06 (1.58-2.69)**	**<0.001**	**2.07 (1.58-2.72)**	**<0.001**	**2.11 (1.60-2.78)**	**<0.001**
4-5 days	431 (71.5)	172 (28.5)	1.26 (0.95-1.68)	0.105	1.27 (0.96-1.68)	0.091	1.33 (1.00-1.78)	0.051
6-7 days	478 (75.3)	157 (24.7)	**Ref.**		**Ref.**		**Ref.**	

Abbreviations: aOR: adjusted odds ratio, CI: Confidence interval.
*Abbreviations: HBSC study: Health Behaviour in School-Aged Children study, aOR: adjusted odds ratio, CI: Confidence interval. *Based on imputed data*
Model 1*:unadjusted,* ***Model 2:*** *included all diet-related behaviours and dietary variables simultaneously adjusted for sociodemographic variables (age category, family affluence score FAS), and physical activity (aOR[a])* ***Model 3:*** *Model 2 included the variable dieting (aOR[b]).*

Table 8. Odds ratios (OR) and associated 95% confidence intervals (CI) from logistic regression models exploring the association of Overweight with diet-related behaviours and habits among 1918 school-aged girls participants in the 2018 Greek arm of the HBSC study*

			Model 1		Model 2		Model 3	
Variables	**Non-Overweight n (%) /mean±sd**	**Overweight-Obese n (%) /mean±sd**	**OR (95% CI)**	**p-value**	**aOR[a] (95% CI)**	**p-value**	**aOR[b] (95% CI)**	**p-value**
Eating breakfast on weekdays								
Never								
1-4 days	447 (78.6)	122 (21.4)	**1.48 (1.12-1.95)**	**0.006**	**1.45 (1.08-1.93)**	**0.013**	**1.47 (1.09-1.98)**	**0.011**
Always (5 days)	398 (80.9)	94 (19.1)	1.30 (0.97-1.74)	0.083	1.27 (0.93-1.74)	0.124	1.22 (0.88-1.71)	0.235
	722 (84.3)	135 (15.7)	**Ref.**		**Ref.**		**Ref.**	
Family meals								
Every day	679 (81.5)	154 (18.5)	**Ref.**		**Ref.**		**Ref.**	
Almost every day	547 (82.5)	116 (17.5)	0.93 (0.69-1.24)	0.602	0.97 (0.70-1.33)	0.833	0.89 (0.64-1.23)	0.464
Rarely	341 (80.8)	81 (19.2)	1.04 (0.76-1.43)	0.795	1.13 (0.81-1.59)	0.478	1.01 (0.71-1.44)	0.964
Total score for behaviour of eating snacks/meals in front of screens (TV/PC/tablet)	2.55 ± 1.67	2.80 ± 1.62	**1.11 (1.04-1.20)**	**0.003**	**1.11 (1.03-1.21)**	**0.008**	**1.12 (1.03-1.22)**	**0.011**
Eating in fast-food restaurants								
Never								
Less than once/month	84 (82.3)	18 (17.7)	**Ref.**		**Ref.**		**Ref.**	
1-3 days/month	445 (78.8)	120 (21.2)	1.21 (0.67-2.17)	0.528	1.18 (0.63-2.20)	0.601	1.07 (0.56-2.03)	0.839
Weekly	706 (83.0)	145 (17.0)	0.92 (0.53-1.61)	0.778	0.85 (0.47-1.55)	0.594	0.71 (0.38-1.32)	0.276
	332 (83.0)	68 (17.0)	0.91 (0.50-1.66)	0.764	0.87 (0.45-1.68)	0.671	0.71 (0.35-1.43)	0.340
Fruits intake								
Less than once/week	136 (85.0)	24 (15.0)	0.95 (0.53-1.69)	0.865	0.79 (0.43-1.45)	0.439	0.89 (0.48-1.65)	0.711
1-4 days/week	683 (79.9)	172(20.1)	**1.34 (1.02-1.75)**	**0.033**	1.18 (0.88-1.59)	0.270	1.23 (0.90-1.68)	0.196
5-6 days/week	219(79.0) 529	58 (21.0)	1.36 (0.95-1.94)	0.090	1.28 (0.89-1.85)	0.185	1.30 (0.89-1.90)	0.171
Every day	(84.5)	97 (15.5)	**Ref.**		**Ref.**		**Ref.**	
Vegetables intake								
Less than once/week	133 (82.1)	29 (17.9)	1.19 (0.75-1.89)	0.456	1.12 (0.68-1.85)	0.657	1.13 (0.67-1.90)	0.658
1-4 days/week	521(79.8) 322	132 (20.2)	1.24 (0.92-1.66)	0.155	1.09 (0.78-1.51)	0.621	1.25 (0.89-1.77)	0.200
5-6 days/week	(81.3)	74 (18.7)	1.15 (0.81-1.64)	0.419	1.16 (0.81-1.66)	0.426	1.26 (0.87-1.82)	0.227
Every day	591 (83.6)	116 (16.4)	**Ref.**		**Ref.**		**Ref.**	

Sweets intake								
Less than once/week	226 (82.5)	48 (17.5)	Ref.		Ref.		Ref.	
1-4 days/week	883 (80.9)	208 (19.1)	1.04 (0.73-1.48)	0.832	1.10 (0.75-1.61)	0.636	1.20 (0.79-1.82)	0.386
5-6 days/week	188(80.0) 270	47 (20.0)	1.11 (0.71-1.74)	0.640	1.16 (0.71-1.90)	0.562	1.52 (0.89-2.61)	0.126
Every day	(84.9)	48 (15.1)	0.77 (0.49-1.20)	0.252	0.72 (0.44-1.18)	0.194	1.04 (0.62-1.74)	0.881
Sugar-sweetened beverage intake								
Less than once/week								
1-4 days/week	894 (83.5)	177 (16.5)	Ref.		Ref.		Ref.	
>5 days/week	538 (79.0)	143 (21.0)	1.30 (1.01-1.66)	0.041	1.23 (0.94-1.61)	0.127	1.23 (0.93-1.64)	0.148
	135 (81.3)	31 (18.7)	1.20 (0.77-1.85)	0.415	1.05 (0.65-1.70)	0.826	1.07 (0.64-1.80)	0.784
Being on a diet or doing something else to lose weight								
No	1,261 (87.3)	183 (12.7)	Ref.				Ref.	
Yes	306 (64.6)	168 (35.4)	3.87 (2.94-5.09)	<0.001			5.39 (4.00-7.25)	<0.001
Age group								
11-year-olds	480 (78.3)	133 (21.7)	Ref.		Ref.		Ref.	
13-year-olds	525 (80.0)	131 (20.0)	0.93 (0.71-1.23)	0.623	0.89 (0.67-1.18)	0.428	0.73 (0.54-0.98)	0.039
15-year-olds	562 (86.6)	87 (13.4)	0.55 (0.40-0.76)	<0.001	0.50 (0.35-0.70)	<0.001	0.36 (0.26-0.52)	<0.001
Family Affluence scale (FAS)								
Low 20% affluence	197 (70.9)	81 (29.1)	Ref.		Ref.		Ref.	
Middle 60% affluence	1029 (82.6)	216 (17.4)	0.51 (0.37-0.70)	<0.001	0.51 (0.37-0.71)	<0.001	0.50 (0.35-0.71)	<0.001
High 20% affluence	341 (86.3)	54 (13.7)	0.38 (0.25-0.58)	<0.001	0.39 (0.25-0.61)	<0.001	0.35 (0.22-0.56)	<0.001
Physical activity (past 7 days)								
0-1 days	190 (76.9)	57 (23.1)	2.02 (1.30-3.14)	0.002	2.14 (1.30-3.53)	0.003	3.14 (1.86-5.28)	<0.001
2-3 days	530 (79.8)	134 (20.2)	1.71 (1.19-2.46)	0.004	1.69 (1.15-2.47)	0.008	1.89 (1.28-2.81)	0.002
4-5 days	486 (82.1)	106 (17.9)	1.48 (1.00-2.19)	0.052	1.51 (1.01-2.26)	0.043	1.58 (1.05-2.37)	0.029
6-7 days	361 (87.0)	54 (13.0)	Ref.		Ref.		Ref.	

Abbreviations: aOR: adjusted odds ratio, CI: Confidence interval.
*Abbreviations: HBSC study: Health Behaviour in School-Aged Children study, aOR: adjusted odds ratio, CI: Confidence interval. *Based on imputed data*
***Model 1**:unadjusted, **Model 2:** included all diet-related behaviours and dietary variables simultaneously adjusted for sociodemographic variables (age category, family affluence score FAS), and physical activity (aOR[a]) **Model 3:** Model 2 included the variable dieting (aOR[b]).*

Discussion

Discussion of the results

In this representative sample of adolescents aged 11-, 13-, and 15-years-old living in Greece almost 1 in 4 adolescents were overweight/obese. Skipping breakfast in the total sample and among girls, eating rarely with the family among boys and eating frequently snacks/meals in front of screens among girls, were all positively associated with being overweight. Being on a diet was positively associated with overweight in the total population and in both genders. Also, being a boy, having a low family affluence score and being physically inactive were all associated with higher odds of being overweight. An inverse association was seen between age and overweight in total sample and among girls. Eating in fast-food restaurants and intake of fruit, vegetables, sweets, and sugar-sweetened beverages were not associated with being overweight.

The prevalence of overweight and obesity among adolescents in this study is in line with previously reported findings from regional, national and cross-national studies (Farajian et al., 2014; Spinelli et al., 2019; Tzotzas et al., 2008), although some have reported lower rates (Georgiadis and Nassis, 2007; Karayiannis et al., 2003; Patsopoulou et al., 2016). Differences in prevalence rates between studies may be attributed to differences in the age of study participants and time periods, differences in the methodology used such as the source of information on body weight and height as well as the reference populations and cut-offs used to define overweight and obesity. In this study we have used the WHO growth charts as reference and the equivalent cut-off points to define overweight and obesity. The WHO growth reference 2007 for school-aged children and adolescents, provides a suitable reference for the 5 to 19 years age group and is recommended by WHO for both clinical and epidemiological use. Currently it is also used as the official growth reference for children and adolescents in Greece (Inchley et al., 2020).

Boys had a greater probability of being overweight compared to girls which is in agreement with previous studies showing that obesity prevalence is greater among boys aged 5–19 years, especially in high and upper middle-income countries worldwide(Dupuy et al., 2011; Georgiadis and Nassis, 2007; Patsopoulou et al., 2016; Shah et al., 2020). Boys tend to have greater prevalence of obesity than girls and that partly maybe be driven by biological factors. Differences in body composition, hormone biology, and certain environmental factors, are causing differences in prevalence of obesity between sexes. Females have higher fat mass and less fat-free mass than males, which is associated with lower body weight and lower body mass index, and with lower energy intake and fewer calorie needs (Wells, 2007; Wisniewski and Chernausek, 2009). Due to higher adiposity, females have increased circulating concentrations of leptin, which is a hormone suppressing appetite and promoting energy utilization. At the same time, higher androgen concentration in males contributes to lower leptin serum concentrations compared to females (Blum et al., 1997; Shah et al., 2020). The role of brown adipose tissue (BAT) might also be linked in the development of obesity. BAT found to be more prevalent in women than in men when examined in adult population, however, more research is needed to better understand the pattern in childhood obesity (Karastergiou et al., 2012). Regarding environmental factors, boys tend to have a higher consumption of soft drinks and calorie-dense foods compared to girls that may prefer lower energy dense foods, such as vegetables and fruits (Benetou et al., 2020; Caine-Bish and Scheule, 2009; Wang et al., 2018). Additionally, girls report higher levels of weight-related concerns more frequent compared to boys, including desire to lose weight or feelings of guilt overeating, a byproduct of the thin ideal and gender-based stereotypes. Parental behavior and perception seem to impact children self-perception of weight, where boys tend to underestimate their body weight, while girls are more likely to overestimate their weight compared to boys(Bauer et al., 2009; Shah et al., 2020; Wang et al., 2018). Lastly, even though boys have higher physical activity levels than girls, boys tend to watch more television or play video games than girls which might lead to higher risk to develop obesity.

Older adolescents were less likely to be overweight/obese in the total sample and among girls, as shown in other studies also (Dupuy et al., 2011; Haug et al., 2009). It could be explained, at least partially, by the fact that as adolescents grow older they become more body-conscious and more vulnerable to sociocultural pressures conforming with specific body stereotypes.

Among diet-related behaviours examined, skipping breakfast was found to be positively associated with overweight in the total sample and among girls. Substantial evidence exists suggesting that breakfast consumption is negatively associated with overweight (Blondin et al., 2016; Dupuy et al., 2011; Farajian et al., 2014; Haug et al., 2009; Monzani et al., 2019; Smith et al., 2010; Szajewska and Ruszczynski, 2010). A recent narrative review highlighted the benefits of regular breakfast consumption on cardiorespiratory fitness, cardiovascular profile, cardiometabolic factors, and quality of life, and resulted to a protective role against childhood obesity (Champilomati et al., 2019). Notably, a Swedish longitudinal study in adolescents with a 27-year follow up, showed that skipping breakfast in adolescence was an important predictor for development of Metabolic Syndrome (MetS), central obesity, and high fasting glucose in adulthood. Breakfast skippers were found to have 2.18 times greater risk of central adiposity compared with breakfast consumers (Wennberg et al., 2015). Additionally, eating breakfast once or less often during weekdays was also associated with poor diet quality in the Greek arm of the HBSC study (Benetou et al., 2020).

A negative association was found between eating family meals and overweight only among boys. This finding is in line with previous studies suggesting that family meals are protective against the development of overweight and obesity during adolescence (Berge et al., 2015; Farajian et al., 2014; Larson et al., 2013). Family meals encourage the social interaction between family members, the consumption of healthier food choices and higher quality foods, and parental dietary modeling, and control the quality and quantity of a child's meal (Farajian et al., 2014; Hammons and Fiese, 2011; Scaglioni et al., 2008).

Eating snacks or meals in front of screens (while watching TV, or while playing on a computer or tablet), measured by an index combining all these behaviours, was not associated with overweight in the whole sample, although a positive statistically significant association was observed among girls. A number of studies have shown that sedentary behaviours such as television, video, or computer use can contribute to overweight, as well as to associated unhealthy snacking (Lipsky and Iannotti, 2012; Utter et al., 2003).

Frequency of eating in fast food restaurants was not associated with overweight and obesity in this sample. This is in agreement with another study conducted in Greece using data from a large representative sample of children and adolescents aged 8-17 years during 2015 (Tambalis et al., 2018). Similarly, French et al. did not find any association between frequency of fast food consumption and overweight status (French et al., 2001). However, frequency of eating fast foods has been associated with higher BMI, excessive fat in children, and elevated risk of childhood obesity in several studies (Krebs et al., 2007; Mancino et al., 2014; St-Onge et al., 2003).

Among the dietary variables examined, frequency of consumption of SSB was not associated with overweight status in the multivariate analysis, a result which is in line with the findings of an analysis based on the 2001-2002 HBSC study using data from 34 participating countries (Janssen et al., 2005). Soft drinks include a variety of drinks that include high amount of sugar, and may lead to an increased energy intake to soft drinks consumers compared to non-consumers (St-Onge et al., 2003). On the other hand, this finding is not in accordance with a substantial body of evidence linking regular consumption of SSB with higher risk of obesity (Bucher Della Torre et al., 2016; Ludwig et al., 2001; Malik et al., 2013). It should be noted that the HBSC questionnaire does not fully capture the range of sugary beverages available on the market, especially fruit juices and smoothies which are quite popular among adolescents. Current WHO guidelines concerning sugar intake for adults and children recommend reducing intake of free sugars to less than 10% of total energy intake. Sugar-sweetened beverages are among those beverages the regular consumption of which should be avoided (Kastorini et al., 2019; World Health Organization, 2015).

No associations were observed between fruit and vegetable consumption and overweight in the current study. Many studies have shown similar findings (Dupuy et al., 2011; Haug et al., 2009; Janssen et al., 2005; Stea et al., 2018), although not all (Serra-Majem et al., 2006). A recent review by Newby on the role of plant-based diets and foods in the prevention of obesity concluded that available data on the role of fruit and vegetables specifically are inconsistent or generally null, and at the same time have several methodological limitations (Newby, 2009). According to Stea et al., when children were given a free school fruit for one year that did not seem to affect their weight status or birth weight of their offspring, 14 years after the intervention (Stea et al., 2018). Nevertheless, the lack of a consistent association with overweight and obesity does not justify any deviation from the recommendation to consume a variety of fruits and vegetables every day.

It is interesting that although a significant negative relationship between overweight and sweets intake (candies and chocolates) was observed in the total sample, the association was no longer statistically significant after controlling for weight-reduction behaviours. This in one of the possible explanations given for the reverse association of sweets intake with obesity found in many studies (Janssen et al., 2005). *Underreporting of* unhealthy food intake of overweight children compared to their non-overweight counterparts and lack of *portion size information* are among others.

Being on a diet or doing something else to lose weight was positively associated with overweight in both genders. Children that reported being on a diet or doing anything else to lose weight appeared to have four times higher odds of being overweight compared to the non-dieters. That is a particularly important finding showing that overweight children are subject to dieting from the sensitive age of adolescence. Teasing, bullying, discrimination, and social exclusion of overweight or obese individuals may trigger an increased engagement with healthy eating from young age, obsession with diet culture, and thus sometimes leading to eating disorders (Ebbeling et al., 2002; Kevin, 2001; Lundstedt et al., 2006; Wilfley et al., 2010). Body dissatisfaction and low self-esteem are also some of the psychosocial complications of childhood obesity that could also enhance a behaviour of dieting to lose weight.

Regular physical activity of moderate to vigorous intensity was negatively and significantly associated with overweight in both girls and boys, a finding consistent with previous knowledge highlighting the importance of regular physical activity in the prevention and management of overweight and obesity throughout the lifetime (Croezen et al., 2009; Sigmund et al., 2015; Swinburn et al., 2011; Townshend and Lake, 2017). Physical activity has been previously addressed as a risk factor of obesity, and particularly abdominal obesity, during adulthood (Pietiläinen et al., 2008).

Lastly, a negative association was evident between family affluence score and overweight, a generally consistent finding highlighing the existence of social inequalities in overweight and obesity among adolescents in Greece(Inchley et al., 2017). Children of low family affluence may have limited opportunity for physical activity, lower quality of diet and a misperception of ideal body weight. This finding is in line with other studies (Costarelli and Manios, 2009; Dupuy et al., 2011; Stamatakis et al., 2010; Thibault et al., 2010)

Strengths and limitations of the study

Our study has several limitations. Its cross-sectional design does not allow us to infer causality for the observed associations. Secondly, all information retrieved was self-reported, thus introducing a degree of information bias into the study. In particular regarding the use of self-reported body weight and height, we assume that the prevalence of overweight has been underestimated compared to calculations based on actual height and weight measurements, an underestimation which could be attributed to recall or social desirability bias and is generally greater among girls and as age and BMI values increase (Himes et al., 2005; Inchley et al., 2017; Sherry et al., 2007). On the other hand, self-reported data of height and weight are commonly used in large epidemiological studies both to derive prevalence estimates and to identify valid relationships (Wang et al., 2002). Furthermore, although the use of BMI alone for classifying obesity has its limitations, BMI has been widely acknowledged as a valid indirect measure of adiposity among children and adolescents worldwide (de Onis and Lobstein, 2010; Rolland-Cachera, 2011). Assessment of fruit, vegetable, sweets and SSBs intake was based on a non-quantitative, self-reported, food frequency questionnaire which did not allow a more detailed and in-depth study, also in terms of quantity, of the association of these food items with excess weight. Also, no information was available for the study of other important food groups, such as meat, dairy, or cereals. Advantages of this study are the representative sample of adolescent participants which allow us to generalise the prevalence of overweight to the general population of adolescents living in Greece, the standardised international protocol of an established multinational survey, the use of WHO growth charts which also allows comparisons between countries, and the large sample size. An additional advantage is the performance of multiple imputation techniques in order to treat missing values (11.8% of the sample had missing values, among which 4.6% on BMI), which allowed us to minimise the possibility of selection bias and reduce the loss of valuable data caused by missing data.

Conclusions

In conclusion, in this representative sample of school-aged adolescents living in Greece, the prevalence of overweight and obesity, is substantial. Diet-related behaviours, such as breakfast consumption, eating more frequently with the family, and avoiding eating in front of the screens, would help to promote a healthier body weight. It is very important to address obesity early in life and avoid its adverse health effect in health and healthcare, as it has been demonstrated that it is more challenging to lose weight after the age of 35 (Katsoulis et al., 2021). Boys, younger age groups, and adolescents from families of lower socioeconomic status are among the populations that need more attention in order to prevent and tackle overweight and obesity.

References

Abarca-Gómez, L., Abdeen, Z., Hamid, Z., Abu-Rmeileh, N., Acosta-Cazares, B., Acuin, C., et al., 2017. NCD Risk Factor Collaboration (NCD-RisC) Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. Lancet 390, 2627–2642. https://doi.org/10.1016/S0140-6736(17)32129-3

Agras, W.S., Hammer, L.D., McNicholas, F., Kraemer, H.C., 2004. Risk factors for childhood overweight: A prospective study from birth to 9.5 years. The Journal of Pediatrics 145, 20–25. https://doi.org/10.1016/j.jpeds.2004.03.023

American Heart Association Childhood Obesity Research Summit Report | Circulation [WWW Document], 2009. URL https://www.ahajournals.org/doi/full/10.1161/circulationaha.109.192216 (accessed 12.3.20).

Anderson, A.D., Solorzano, C.M.B., McCartney, C.R., 2014. Childhood obesity and its impact on the development of adolescent PCOS. Semin Reprod Med 32, 202–213. https://doi.org/10.1055/s-0034-1371092

Anderson, P.M., Butcher, K.F., 2006. Childhood Obesity: Trends and Potential Causes. The Future of Children 16, 19–45.

Banerjee, A., Schuster, D.P., 2012. Comorbidities of Childhood Obesity. Childhood Obesity. https://doi.org/10.5772/33612

Barreira, T.V., Broyles, S.T., Gupta, A.K., Katzmarzyk, P.T., 2014. Relationship of Anthropometric Indices to Abdominal and Total Body Fat in Youth: Sex and Race Differences. Obesity (Silver Spring) 22, 1345–1350. https://doi.org/10.1002/oby.20714

Bauer, K.W., Larson, N.I., Nelson, M.C., Story, M., Neumark-Sztainer, D., 2009. Socio-environmental, personal and behavioural predictors of fast-food intake among adolescents. Public Health Nutrition 12, 1767–1774. https://doi.org/10.1017/S1368980008004394

Benetou, V., Kanellopoulou, A., Kanavou, E., Fotiou, A., Stavrou, M., Richardson, C., Orfanos, P., Kokkevi, A., 2020. Diet-Related Behaviors and Diet Quality among School-Aged Adolescents Living in Greece. Nutrients 12, 3804. https://doi.org/10.3390/nu12123804

Berardis, S., Sokal, E., 2014. Pediatric non-alcoholic fatty liver disease: an increasing public health issue. Eur J Pediatr 173, 131–139. https://doi.org/10.1007/s00431-013-2157-6

Berge, J.M., Wall, M., Hsueh, T.-F., Fulkerson, J.A., Larson, N., Neumark-Sztainer, D., 2015. The Protective Role of Family Meals for Youth Obesity: 10-Year Longitudinal Associations. The Journal of Pediatrics 166, 296–301. https://doi.org/10.1016/j.jpeds.2014.08.030

Berkey, C.S., Rockett, H.R.H., Field, A.E., Gillman, M.W., Colditz, G.A., 2004. Sugar-added beverages and adolescent weight change. Obes Res 12, 778–788. https://doi.org/10.1038/oby.2004.94

Blondin, S.A., Anzman-Frasca, S., Djang, H.C., Economos, C.D., 2016. Breakfast consumption and adiposity among children and adolescents: an updated review of the literature. Pediatr Obes 11, 333–348. https://doi.org/10.1111/ijpo.12082

Blum, W.F., Englaro, P., Hanitsch, S., Juul, A., Hertel, N.T., Müller, J., Skakkebaek, N.E., Heiman, M.L., Birkett, M., Attanasio, A.M., Kiess, W., Rascher, W., 1997. Plasma leptin levels in healthy children and adolescents: dependence on body mass index, body fat mass, gender, pubertal stage, and testosterone. J Clin Endocrinol Metab 82, 2904–2910. https://doi.org/10.1210/jcem.82.9.4251

Bucher Della Torre, S., Keller, A., Laure Depeyre, J., Kruseman, M., 2016. Sugar-Sweetened Beverages and Obesity Risk in Children and Adolescents: A Systematic Analysis on How Methodological Quality May Influence Conclusions. J Acad Nutr Diet 116, 638–659. https://doi.org/10.1016/j.jand.2015.05.020

Buitrago-Lopez, A., Sanderson, J., Johnson, L., Warnakula, S., Wood, A., Angelantonio, E.D., Franco, O.H., 2011. Chocolate consumption and cardiometabolic disorders: systematic review and meta-analysis. BMJ 343, d4488. https://doi.org/10.1136/bmj.d4488

Caine-Bish, N.L., Scheule, B., 2009. Gender differences in food preferences of school-aged children and adolescents. J Sch Health 79, 532–540. https://doi.org/10.1111/j.1746-1561.2009.00445.x

Champilomati, G., Notara, V., Panagiotakos, D., 2019. Breakfast consumption and childhood obesity. J Atherosclerosis Prev Treat 9.

Chang, L., Neu, J., 2015. Early Factors Leading to Later Obesity: Interactions of the Microbiome, Epigenome, and Nutrition. Current Problems in Pediatric and Adolescent Health Care, Early Factors Leading to Later Obesity: Interactions of the Microbiome, Epigenome and Nutrition 45, 134–142. https://doi.org/10.1016/j.cppeds.2015.03.003

Chavarro, J.E., Martín-Calvo, N., Yuan, C., Arvizu, M., Rich-Edwards, J.W., Michels, K.B., Sun, Q., 2020. Association of Birth by Cesarean Delivery With Obesity and Type 2 Diabetes Among Adult Women. JAMA Netw Open 3, e202605. https://doi.org/10.1001/jamanetworkopen.2020.2605

Cheung, W.W., Mao, P., 2012. Recent Advances in Obesity: Genetics and Beyond [WWW Document]. ISRN Endocrinology. https://doi.org/10.5402/2012/536905

Cole, T.J., Bellizzi, M.C., Flegal, K.M., Dietz, W.H., 2000. Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ 320, 1240. https://doi.org/10.1136/bmj.320.7244.1240

Cole, T.J., Flegal, K.M., Nicholls, D., Jackson, A.A., 2007. Body mass index cut offs to define thinness in children and adolescents: international survey. BMJ 335, 194. https://doi.org/10.1136/bmj.39238.399444.55

Cole, T.J., Lobstein, T., 2012. Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity: Extended international BMI cut-offs. Pediatric Obesity 7, 284–294. https://doi.org/10.1111/j.2047-6310.2012.00064.x

Collado, M.C., Isolauri, E., Laitinen, K., Salminen, S., 2010. Effect of mother's weight on infant's microbiota acquisition, composition, and activity during early infancy: a prospective follow-up study initiated in early pregnancy. Am J Clin Nutr 92, 1023–1030. https://doi.org/10.3945/ajcn.2010.29877

Costarelli, V., Manios, Y., 2009. The influence of socioeconomic status and ethnicity on children's excess body weight. Nutrition & Food Science 39, 676–684. https://doi.org/10.1108/00346650911003002

Croezen, S., Visscher, T.L.S., Ter Bogt, N.C.W., Veling, M.L., Haveman-Nies, A., 2009. Skipping breakfast, alcohol consumption and physical inactivity as risk factors for overweight and obesity in adolescents: results of the E-MOVO project. Eur J Clin Nutr 63, 405–412. https://doi.org/10.1038/sj.ejcn.1602950

Currie, C., Ahluwalia, N., Godeau, E., Nic Gabhainn, S., Due, P., Currie, D.B., 2012. Is Obesity at Individual and National Level Associated With Lower Age at Menarche? Evidence From 34 Countries in the Health Behaviour in School-aged Children Study. Journal of Adolescent Health 50, 621–626. https://doi.org/10.1016/j.jadohealth.2011.10.254

Currie, C., Nic Gabhainn, S., Godeau, E., the International HBSC Network Coordinating Committee, 2009. The Health Behaviour in School-aged Children: WHO Collaborative Cross-National (HBSC) Study: origins, concept, history and development 1982–2008. Int J Public Health 54, 131–139. https://doi.org/10.1007/s00038-009-5404-x

Dallacker, M., Hertwig, R., Mata, J., 2018. The frequency of family meals and nutritional health in children: a meta-analysis. Obesity Reviews 19, 638–653. https://doi.org/10.1111/obr.12659

Darmasseelane, K., Hyde, M.J., Santhakumaran, S., Gale, C., Modi, N., 2014. Mode of delivery and offspring body mass index, overweight and obesity in adult life: a systematic review and meta-analysis. PLoS One 9, e87896. https://doi.org/10.1371/journal.pone.0087896

Davidson, L.M., Millar, K., Jones, C., Fatum, M., Coward, K., 2015. Deleterious effects of obesity upon the hormonal and molecular mechanisms controlling spermatogenesis and male fertility. Hum Fertil (Camb) 18, 184–193. https://doi.org/10.3109/14647273.2015.1070438

Davison, K.K., Birch, L.L., 2001. Weight status, parent reaction, and self-concept in five-year-old girls. Pediatrics 107, 46–53. https://doi.org/10.1542/peds.107.1.46

de Onis, M., Lobstein, T., 2010. Defining obesity risk status in the general childhood population: Which cut-offs should we use? International Journal of Pediatric Obesity 5, 458–460. https://doi.org/10.3109/17477161003615583

de Onis, M., Onyango, A.W., Borghi, E., Siyam, A., Nishida, C., Siekmann, J., 2007. Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ 85, 660–667. https://doi.org/10.2471/blt.07.043497

Di Cesare, M., Sorić, M., Bovet, P., Miranda, J.J., Bhutta, Z., Stevens, G.A., Laxmaiah, A., Kengne, A.-P., Bentham, J., 2019. The epidemiological burden of obesity in childhood: a worldwide epidemic requiring urgent action. BMC Med 17. https://doi.org/10.1186/s12916-019-1449-8

Du Plessis, S.S., Cabler, S., McAlister, D.A., Sabanegh, E., Agarwal, A., 2010. The effect of obesity on sperm disorders and male infertility. Nat Rev Urol 7, 153–161. https://doi.org/10.1038/nrurol.2010.6

Dupuy, M., Godeau, E., Vignes, C., Ahluwalia, N., 2011. Socio-demographic and lifestyle factors associated with overweight in a representative sample of 11-15 year olds in France: results from the WHO-Collaborative Health Behaviour in School-aged Children (HBSC) cross-sectional study. BMC Public Health 11, 442. https://doi.org/10.1186/1471-2458-11-442

Ebbeling, C.B., Pawlak, D.B., Ludwig, D.S., 2002. Childhood obesity: public-health crisis, common sense cure. The Lancet 360, 473–482. https://doi.org/10.1016/S0140-6736(02)09678-2

Egan, K.B., Ettinger, A.S., Bracken, M.B., 2013. Childhood body mass index and subsequent physician-diagnosed asthma: a systematic review and meta-analysis of prospective cohort studies. BMC Pediatr 13, 121. https://doi.org/10.1186/1471-2431-13-121

Farajian, P., Panagiotakos, D.B., Risvas, G., Malisova, O., Zampelas, A., 2014. Hierarchical analysis of dietary, lifestyle and family environment risk factors for childhood obesity: the GRECO study. Eur J Clin Nutr 68, 1107–1112. https://doi.org/10.1038/ejcn.2014.89

Farajian, P., Risvas, G., Karasouli, K., Pounis, G.D., Kastorini, C.M., Panagiotakos, D.B., Zampelas, A., 2011. Very high childhood obesity prevalence and low adherence rates to the Mediterranean diet in Greek children: the GRECO study. Atherosclerosis 217, 525–530. https://doi.org/10.1016/j.atherosclerosis.2011.04.003

Field, A.E., Laird, N., Steinberg, E., Fallon, E., Semega-Janneh, M., Yanovski, J.A., 2003. Which Metric of Relative Weight Best Captures Body Fatness in Children? Obesity Research 11, 1345–1352. https://doi.org/10.1038/oby.2003.182

Fisher, J.O., Liu, Y., Birch, L.L., Rolls, B.J., 2007. Effects of portion size and energy density on young children’s intake at a meal. The American Journal of Clinical Nutrition 86, 174–179. https://doi.org/10.1093/ajcn/86.1.174

Freedman, D.S., Dietz, W.H., Tang, R., Mensah, G.A., Bond, M.G., Urbina, E.M., Srinivasan, S., Berenson, G.S., 2004. The relation of obesity throughout life to carotid intima-media thickness in adulthood: the Bogalusa Heart Study. Int J Obes Relat Metab Disord 28, 159–166. https://doi.org/10.1038/sj.ijo.0802515

Freedman, D.S., Khan, L.K., Serdula, M.K., Dietz, W.H., Srinivasan, S.R., Berenson, G.S., 2005. The Relation of Childhood BMI to Adult Adiposity: The Bogalusa Heart Study. Pediatrics 115, 22–27. https://doi.org/10.1542/peds.2004-0220

Freedman, D.S., Mei, Z., Srinivasan, S.R., Berenson, G.S., Dietz, W.H., 2007. Cardiovascular Risk Factors and Excess Adiposity Among Overweight Children and Adolescents: The Bogalusa Heart Study. The Journal of Pediatrics 150, 12-17.e2. https://doi.org/10.1016/j.jpeds.2006.08.042

Freedman, D.S., Serdula, M.K., Srinivasan, S.R., Berenson, G.S., 1999. Relation of circumferences and skinfold thicknesses to lipid and insulin concentrations in children and adolescents: the Bogalusa Heart Study. Am J Clin Nutr 69, 308–317. https://doi.org/10.1093/ajcn/69.2.308

French, S.A., Story, M., Neumark-Sztainer, D., Fulkerson, J.A., Hannan, P., 2001. Fast food restaurant use among adolescents: associations with nutrient intake, food choices and behavioral and psychosocial variables. International Journal of Obesity 25, 1823–1833. https://doi.org/10.1038/sj.ijo.0801820

Gasser, C.E., Mensah, F.K., Russell, M., Dunn, S.E., Wake, M., 2016. Confectionery consumption and overweight, obesity, and related outcomes in children and adolescents: a systematic review and meta-analysis. The American Journal of Clinical Nutrition 103, 1344–1356. https://doi.org/10.3945/ajcn.115.119883

Georgiadis, G., Nassis, G.P., 2007. Prevalence of overweight and obesity in a national representative sample of Greek children and adolescents. Eur J Clin Nutr 61, 1072–1074. https://doi.org/10.1038/sj.ejcn.1602619

Griffiths, L., Parsons, T., Hill, A., 2010. Self-esteem and quality of life in obese children and adolescents: A systematic review. International journal of pediatric obesity : IJPO : an official journal of the International Association for the Study of Obesity 5, 282–304. https://doi.org/10.3109/17477160903473697

Guo, S.S., Huang, C., Maynard, L.M., Demerath, E., Towne, B., Chumlea, W.C., Siervogel, R.M., 2000. Body mass index during childhood, adolescence and young adulthood in relation to adult overweight and adiposity: the Fels Longitudinal Study. Int J Obes Relat Metab Disord 24, 1628–1635. https://doi.org/10.1038/sj.ijo.0801461

Guthold, R., Stevens, G.A., Riley, L.M., Bull, F.C., 2020. Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1·6 million participants. The Lancet Child & Adolescent Health 4, 23–35. https://doi.org/10.1016/S2352-4642(19)30323-2

Hammons, A.J., Fiese, B.H., 2011. Is frequency of shared family meals related to the nutritional health of children and adolescents? Pediatrics 127, e1565-1574. https://doi.org/10.1542/peds.2010-1440

Harder, T., Bergmann, R., Kallischnigg, G., Plagemann, A., 2005. Duration of breastfeeding and risk of overweight: a meta-analysis. Am J Epidemiol 162, 397–403. https://doi.org/10.1093/aje/kwi222

Haug, E., Rasmussen, M., Samdal, O., Iannotti, R., Kelly, C., Borraccino, A., Vereecken, C., Melkevik, O., Lazzeri, G., Giacchi, M., Ercan, O., Due, P., Ravens-Sieberer, U., Currie, C., Morgan, A., Ahluwalia, N., 2009. Overweight in school-aged children and its relationship with demographic and lifestyle factors: Results from the WHO-Collaborative Health Behaviour in School-aged Children (HBSC) Study. Int J Public Health 54, 167–179. https://doi.org/10.1007/s00038-009-5408-6

Hayden-Wade, H.A., Stein, R.I., Ghaderi, A., Saelens, B.E., Zabinski, M.F., Wilfley, D.E., 2005. Prevalence, Characteristics, and Correlates of Teasing Experiences among Overweight Children vs. Non-overweight Peers. Obesity Research 13, 1381–1392. https://doi.org/10.1038/oby.2005.167

He, Y., Tian, J., Oddy, W.H., Dwyer, T., Venn, A.J., 2018. Association of childhood obesity with female infertility in adulthood: a 25-year follow-up study. Fertility and Sterility 110, 596-604.e1. https://doi.org/10.1016/j.fertnstert.2018.05.011

Herrera, B.M., Keildson, S., Lindgren, C.M., 2011. Genetics and epigenetics of obesity. Maturitas 69, 41–49. https://doi.org/10.1016/j.maturitas.2011.02.018

Hills, A.P., Andersen, L.B., Byrne, N.M., 2011. Physical activity and obesity in children. Br J Sports Med 45, 866–870. https://doi.org/10.1136/bjsports-2011-090199

Hills, A.P., King, N.A., Armstrong, T.P., 2007. The Contribution of Physical Activity and Sedentary Behaviours to the Growth and Development of Children and Adolescents. Sports Med 37, 533–545. https://doi.org/10.2165/00007256-200737060-00006

Himes, J.H., Hannan, P., Wall, M., Neumark-Sztainer, D., 2005. Factors associated with errors in self-reports of stature, weight, and body mass index in Minnesota adolescents. Ann Epidemiol 15, 272–278. https://doi.org/10.1016/j.annepidem.2004.08.010

Inchley, J., Currie, D., Budisavljevic, S., Torsheim, T., Jåstad, A., Cosma, A., Colette, K., Arnarsson, Á.M., Samdal, O., 2020. Spotlight on adolescent health and well-being. Findings from the 2017/2018 Health Behaviour in School-aged Children (HBSC) survey in Europe and Canada. International report. Volume 2. Key data [WWW Document]. URL https://www.euro.who.int/en/health-topics/Life-stages/child-and-adolescent-health/health-behaviour-in-school-aged-children-hbsc/publications/2020/spotlight-on-adolescent-health-and-well-being.-findings-from-the-20172018-health-behaviour-in-school-aged-children-hbsc-survey-in-europe-and-canada.-international-report.-volume-2.-key-data (accessed 5.23.21).

Inchley, J., World Health Organization, Regional Office for Europe, 2017. Adolescent obesity and related behaviours: trends and inequalities in the who european region, 2002-2014 : observations from the Health Behavior in School-aged Children (HBSC) WHO collaborative cross-national study. World Health Organization, Regional Office for europe, Copenhagen.

Janssen, I., Katzmarzyk, P.T., Boyce, W.F., Vereecken, C., Mulvihill, C., Roberts, C., Currie, C., Pickett, W., Health Behaviour in School-Aged Children Obesity Working Group, 2005. Comparison of overweight and obesity prevalence in school-aged youth from 34 countries and their relationships with physical activity and dietary patterns. Obes Rev 6, 123–132. https://doi.org/10.1111/j.1467-789X.2005.00176.x

Janssen, I., LeBlanc, A.G., 2010. Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. International Journal of Behavioral Nutrition and Physical Activity 7, 40. https://doi.org/10.1186/1479-5868-7-40

Kanellopoulou, A., Giannakopoulou, S.-P., Notara, V., Antonogeorgos, G., Rojas-Gil, A.P., Kornilaki, E.N., Konstantinou, E., Lagiou, A., Panagiotakos, D.B., 2021. The association between adherence to the Mediterranean diet and childhood obesity; the role of family structure: Results from an epidemiological study in 1728 Greek students. Nutr Health 27, 39–47. https://doi.org/10.1177/0260106020952600

Karastergiou, K., Smith, S.R., Greenberg, A.S., Fried, S.K., 2012. Sex differences in human adipose tissues - the biology of pear shape. Biol Sex Differ 3, 13. https://doi.org/10.1186/2042-6410-3-13

Karayiannis, D., Yannakoulia, M., Terzidou, M., Sidossis, L.S., Kokkevi, A., 2003. Prevalence of overweight and obesity in Greek school-aged children and adolescents. Eur J Clin Nutr 57, 1189–1192. https://doi.org/10.1038/sj.ejcn.1601743

Kastorini, C.-M., Critselis, E., Zota, D., Coritsidis, A.L., Nagarajan, M.K., Papadimitriou, E., Belogianni, K., Benetou, V., Linos, A., Team, on behalf of the G.N.D.G.S., 2019. National Dietary Guidelines of Greece for children and adolescents: a tool for promoting healthy eating habits. Public Health Nutrition 22, 2688–2699. https://doi.org/10.1017/S1368980019001034

Katsoulis, M., Lai, A.G., Diaz-Ordaz, K., Gomes, M., Pasea, L., Banerjee, A., Denaxas, S., Tsilidis, K., Lagiou, P., Misirli, G., Bhaskaran, K., Wannamethee, G., Dobson, R., Batterham, R.L., Kipourou, D.-K., Lumbers, R.T., Wen, L., Wareham, N., Langenberg, C., Hemingway, H., 2021. Identifying adults at high-risk for change in weight and BMI in England: a longitudinal, large-scale, population-based cohort study using electronic health records. The Lancet Diabetes & Endocrinology 0. https://doi.org/10.1016/S2213-8587(21)00207-2

Katzmarzyk, P., Janssen, I., Morrison, K.M., 2007. Classification of overweight and obesity in children and adolescents. CMAJ 176, 27–32.

Keller, A., Bucher Della Torre, S., 2015. Sugar-Sweetened Beverages and Obesity among Children and Adolescents: A Review of Systematic Literature Reviews. Child Obes 11, 338–346. https://doi.org/10.1089/chi.2014.0117

Kelly, B., Halford, J.C.G., Boyland, E.J., Chapman, K., Bautista-Castaño, I., Berg, C., Caroli, M., Cook, B., Coutinho, J.G., Effertz, T., Grammatikaki, E., Keller, K., Leung, R., Manios, Y., Monteiro, R., Pedley, C., Prell, H., Raine, K., Recine, E., Serra-Majem, L., Singh, S., Summerbell, C., 2010. Television Food Advertising to Children: A Global Perspective. Am J Public Health 100, 1730–1736. https://doi.org/10.2105/AJPH.2009.179267

Kevin, T.J., 2001. Body Image, Eating Disorders, and Obesity in Youth: Assessment, Prevention, and Treatment. Taylor & Francis.

Koca, T., Akcam, M., Serdaroglu, F., Dereci, S., 2017. Breakfast habits, dairy product consumption, physical activity, and their associations with body mass index in children aged 6-18. Eur J Pediatr 176, 1251–1257. https://doi.org/10.1007/s00431-017-2976-y

Kokkevi, A., Stavrou, M., Kanavou, E., Fotiou, A., 2015. Eating behaviour, physical activity and body weight in adolescents. Series of Short Reports: Adolescents, Behaviours & Health. University Mental Health Research Institute. Athens.

Kostopoulou, E., Tsekoura, E., Fouzas, S., Gkentzi, D., Jelastopulu, E., Varvarigou, A., 2021. Association of lifestyle factors with a high prevalence of overweight and obesity in Greek children aged 10–16 years. Acta Paediatrica 110, 3356–3364. https://doi.org/10.1111/apa.15960

Krebs, N.F., Himes, J.H., Jacobson, D., Nicklas, T.A., Guilday, P., Styne, D., 2007. Assessment of Child and Adolescent Overweight and Obesity. Pediatrics 120, S193–S228. https://doi.org/10.1542/peds.2007-2329D

Kumar, S., Kelly, A.S., 2017. Review of Childhood Obesity: From Epidemiology, Etiology, and Comorbidities to Clinical Assessment and Treatment. Mayo Clinic Proceedings 92, 251–265. https://doi.org/10.1016/j.mayocp.2016.09.017

Laitinen, J., Taponen, S., Martikainen, H., Pouta, A., Millwood, I., Hartikainen, A.-L., Ruokonen, A., Sovio, U., McCarthy, M.I., Franks, S., Järvelin, M.R., 2003. Body size from birth to adulthood as a predictor of self-reported polycystic ovary syndrome symptoms. International Journal of Obesity 27, 710–715. https://doi.org/10.1038/sj.ijo.0802301

Lakshman, R., Elks, C.E., Ong, K.K., 2012. CHILDHOOD OBESITY. Circulation 126, 1770–1779. https://doi.org/10.1161/CIRCULATIONAHA.111.047738

Lang, J.E., Bunnell, H.T., Hossain, M.J., Wysocki, T., Lima, J.J., Finkel, T.H., Bacharier, L., Dempsey, A., Sarzynski, L., Test, M., Forrest, C.B., 2018. Being Overweight or Obese and the Development of Asthma. Pediatrics 142. https://doi.org/10.1542/peds.2018-2119

Larson, N., MacLehose, R., Fulkerson, J.A., Berge, J.M., Story, M., Neumark-Sztainer, D., 2013. Eating Breakfast and Dinner Together as a Family: Associations with Sociodemographic Characteristics and Implications for Diet Quality and Weight Status. Journal of the Academy of Nutrition and Dietetics 113, 1601–1609. https://doi.org/10.1016/j.jand.2013.08.011

Leiba, A., Kark, J.D., Afek, A., Derazne, E., Barchana, M., Tzur, D., Vivante, A., Shamiss, A., 2013. Adolescent obesity and paternal country of origin predict renal cell carcinoma: a cohort study of 1.1 million 16 to 19-year-old males. J Urol 189, 25–29. https://doi.org/10.1016/j.juro.2012.08.184

Leiba, M., Leiba, A., Keinan-Boker, L., Avigdor, A., Derazne, E., Levine, H., Kark, J.D., 2016. Adolescent weight and height are predictors of specific non-Hodgkin lymphoma subtypes among a cohort of 2,352,988 individuals aged 16 to 19 years. Cancer 122, 1068–1077. https://doi.org/10.1002/cncr.29792

Levi, Z., Kark, J.D., Afek, A., Derazne, E., Tzur, D., Furman, M., Gordon, B., Barchana, M., Liphshitz, I., Niv, Y., Shamiss, A., 2012. Measured body mass index in adolescence and the incidence of pancreatic cancer in a cohort of 720,000 Jewish men. Cancer Causes Control 23, 371–378. https://doi.org/10.1007/s10552-011-9886-5

Levi, Z., Kark, J.D., Barchana, M., Liphshitz, I., Zavdi, O., Tzur, D., Derazne, E., Furman, M., Niv, Y., Gordon, B., Afek, A., Shamiss, A., 2011. Measured body mass index in adolescence and the incidence of colorectal cancer in a cohort of 1.1 million males. Cancer Epidemiol Biomarkers Prev 20, 2524–2531. https://doi.org/10.1158/1055-9965.EPI-11-0531

Levi, Z., Kark, J.D., Shamiss, A., Derazne, E., Tzur, D., Keinan-Boker, L., Liphshitz, I., Niv, Y., Furman, M., Afek, A., 2013. Body mass index and socioeconomic status measured in adolescence, country of origin, and the incidence of gastroesophageal adenocarcinoma in a cohort of 1 million men. Cancer 119, 4086–4093. https://doi.org/10.1002/cncr.28241

Li, W., Liu, Q., Deng, X., Chen, Y., Liu, S., Story, M., 2017. Association between Obesity and Puberty Timing: A Systematic Review and Meta-Analysis. Int J Environ Res Public Health 14. https://doi.org/10.3390/ijerph14101266

Lin, B.-H., Guthrie, J.F., 2012. Nutritional Quality of Food Prepared at Home and Away From Home, 1977-2008 [WWW Document]. AgEcon Search. https://doi.org/10.22004/ag.econ.142361

Lipsky, L.M., Iannotti, R.J., 2012. Associations of television viewing with eating behaviors in the 2009 Health Behaviour in School-aged Children Study. Arch Pediatr Adolesc Med 166, 465–472. https://doi.org/10.1001/archpediatrics.2011.1407

Ludwig, D.S., Peterson, K.E., Gortmaker, S.L., 2001. Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. Lancet 357, 505–508. https://doi.org/10.1016/S0140-6736(00)04041-1

Lundstedt, G., Edlund, B., Engström, I., Thurfjell, B., Marcus, C., 2006. Eating disorder traits in obese children and adolescents. Eat Weight Disord 11, 45–50. https://doi.org/10.1007/BF03327743

Ma, J., Qiao, Y., Zhao, P., Li, W., Katzmarzyk, P.T., Chaput, J.-P., Fogelholm, M., Kuriyan, R., Lambert, E.V., Maher, C., Maia, J., Matsudo, V., Olds, T., Onywera, V., Sarmiento, O.L., Standage, M., Tremblay, M.S., Tudor-Locke, C., Hu, G., 2020. Breastfeeding and childhood obesity: A 12-country study. Maternal & Child Nutrition 16, e12984. https://doi.org/10.1111/mcn.12984

Malik, V.S., Pan, A., Willett, W.C., Hu, F.B., 2013. Sugar-sweetened beverages and weight gain in children and adults: a systematic review and meta-analysis123. Am J Clin Nutr 98, 1084–1102. https://doi.org/10.3945/ajcn.113.058362

Malis, C., Rasmussen, E.L., Poulsen, P., Petersen, I., Christensen, K., Beck-Nielsen, H., Astrup, A., Vaag, A.A., 2005. Total and regional fat distribution is strongly influenced by genetic factors in young and elderly twins. Obes Res 13, 2139–2145. https://doi.org/10.1038/oby.2005.265

Mancino, L., Todd, J.E., Guthrie, J., Lin, B.-H., 2014. Food Away from Home and Childhood Obesity. Curr Obes Rep 3, 459–469. https://doi.org/10.1007/s13679-014-0121-z

Monzani, A., Ricotti, R., Caputo, M., Solito, A., Archero, F., Bellone, S., Prodam, F., 2019. A Systematic Review of the Association of Skipping Breakfast with Weight and Cardiometabolic Risk Factors in Children and Adolescents. What Should We Better Investigate in the Future? Nutrients 11. https://doi.org/10.3390/nu11020387

Morenga, L.T., Mallard, S., Mann, J., 2013. Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. BMJ 346, e7492. https://doi.org/10.1136/bmj.e7492

Must, A., Jacques, P.F., Dallal, G.E., Bajema, C.J., Dietz, W.H., 1992. Long-Term Morbidity and Mortality of Overweight Adolescents. New England Journal of Medicine 327, 1350–1355. https://doi.org/10.1056/NEJM199211053271904

NCD-RisC. NCD Risk Factor Collaboration., 2017. World Map - Obesity > BMI > Data Visualisations > NCD-RisC [WWW Document]. URL http://www.ncdrisc.org/ (accessed 10.8.20).

Nelson, M.C., Neumark-Sztainer, D., Hannan, P.J., Story, M., 2009. Five-Year Longitudinal and Secular Shifts in Adolescent Beverage Intake: Findings from Project EAT (Eating Among Teens)-II. Journal of the American Dietetic Association 109, 308–312. https://doi.org/10.1016/j.jada.2008.10.043

Newby, P.K., 2009. Plant foods and plant-based diets: protective against childhood obesity? Am J Clin Nutr 89, 1572S-1587S. https://doi.org/10.3945/ajcn.2009.26736G

Ng, K., Psychology, J.F., Abdrakhmanova, S., Adayeva, A., 2019. Physical activity and screen time among children and adolescents in Kazakhstan. https://doi.org/10.31382/eqol.191202

Nittari, G., Scuri, S., Sagaro, G.G., Petrelli, F., Grappasonni, I., 2020. Epidemiology of Obesity in Children and Adolescents, Teamwork in Healthcare. IntechOpen. https://doi.org/10.5772/intechopen.93604

Obesity Classification [WWW Document], 2012. . World Obesity Federation. URL https://www.worldobesity.org/about/about-obesity/obesity-classification (accessed 12.8.20).

Onis, M. de, 2006. WHO Child Growth Standards based on length/height, weight and age. Acta Paediatrica 95, 76–85. https://doi.org/10.1111/j.1651-2227.2006.tb02378.x

Park, M.H., Falconer, C., Viner, R.M., Kinra, S., 2012. The impact of childhood obesity on morbidity and mortality in adulthood: a systematic review. Obesity Reviews 13, 985–1000. https://doi.org/10.1111/j.1467-789X.2012.01015.x

Parker, E.D., Sinaiko, A.R., Kharbanda, E.O., Margolis, K.L., Daley, M.F., Trower, N.K., Sherwood, N.E., Greenspan, L.C., Lo, J.C., Magid, D.J., O'Connor, P.J., 2016. Change in Weight Status and Development of Hypertension. Pediatrics 137. https://doi.org/10.1542/peds.2015-1662

Patsopoulou, A., Tsimtsiou, Z., Katsioulis, A., Rachiotis, G., Malissiova, E., Hadjichristodoulou, C., 2016. Prevalence and Risk Factors of Overweight and Obesity among Adolescents and Their Parents in Central Greece (FETA Project). Int J Environ Res Public Health 13. https://doi.org/10.3390/ijerph13010083

Pietiläinen, K.H., Kaprio, J., Borg, P., Plasqui, G., Yki-Järvinen, H., Kujala, U.M., Rose, R.J., Westerterp, K.R., Rissanen, A., 2008. Physical Inactivity and Obesity: A Vicious Circle. Obesity 16, 409–414. https://doi.org/10.1038/oby.2007.72

Poynter, J.N., Richardson, M., Blair, C.K., Roesler, M.A., Hirsch, B.A., Nguyen, P., Cioc, A., Warlick, E., Cerhan, J.R., Ross, J.A., 2016. Obesity over the life course and risk of acute myeloid leukemia and myelodysplastic syndromes. Cancer Epidemiol 40, 134–140. https://doi.org/10.1016/j.canep.2015.12.005

Quek, Y.-H., Tam, W.W.S., Zhang, M.W.B., Ho, R.C.M., 2017. Exploring the association between childhood and adolescent obesity and depression: a meta-analysis. Obesity Reviews 18, 742–754. https://doi.org/10.1111/obr.12535

Rankin, J., Matthews, L., Cobley, S., Han, A., Sanders, R., Wiltshire, H.D., Baker, J.S., 2016. Psychological consequences of childhood obesity: psychiatric comorbidity and prevention. Adolesc Health Med Ther 7, 125–146. https://doi.org/10.2147/AHMT.S101631

Ranucci, G., Spagnuolo, M.I., Iorio, R., 2017. Obese children with fatty liver: Between reality and disease mongering. World J Gastroenterol 23, 8277–8282. https://doi.org/10.3748/wjg.v23.i47.8277

Redline, S., Tishler, P.V., Schluchter, M., Aylor, J., Clark, K., Graham, G., 1999. Risk factors for sleep-disordered breathing in children. Associations with obesity, race, and respiratory problems. Am J Respir Crit Care Med 159, 1527–1532. https://doi.org/10.1164/ajrccm.159.5.9809079

Rito, A.I., Buoncristiano, M., Spinelli, A., Salanave, B., Kunešová, M., Hejgaard, T., García Solano, M., Fijałkowska, A., Sturua, L., Hyska, J., Kelleher, C., Duleva, V., Musić Milanović, S., Farrugia Sant'Angelo, V., Abdrakhmanova, S., Kujundzic, E., Peterkova, V., Gualtieri, A., Pudule, I., Petrauskienė, A., Tanrygulyyeva, M., Sherali, R., Huidumac-Petrescu, C., Williams, J., Ahrens, W., Breda, J., 2019. Association between Characteristics at Birth, Breastfeeding and Obesity in 22 Countries: The WHO European Childhood Obesity Surveillance Initiative – COSI 2015/2017. OFA 12, 226–243. https://doi.org/10.1159/000500425

Roberts, K.C., Shields, M., de Groh, M., Aziz, A., Gilbert, J.-A., 2012. Overweight and obesity in children and adolescents: results from the 2009 to 2011 Canadian Health Measures Survey. Health Rep 23, 37–41.

Roditis, M.L., Parlapani, E.S., Tzotzas, T., Hassapidou, M., Krassas, G.E., 2009. Epidemiology and predisposing factors of obesity in Greece: from the Second World War until today. Journal of pediatric endocrinology & metabolism: JPEM 22, 389–405. https://doi.org/10.1515/jpem.2009.22.5.389

Rolland-Cachera, M.F., 2012. Towards a simplified definition of childhood obesity? A focus on the extended IOTF references. Pediatric Obesity 7, 259–260. https://doi.org/10.1111/j.2047-6310.2012.00077.x

Rolland-Cachera, M.F., 2011. Childhood obesity: current definitions and recommendations for their use. Int J Pediatr Obes 6, 325–331. https://doi.org/10.3109/17477166.2011.607458

Roseman, M.G., Yeung, W.K., Nickelsen, J., 2007. Examination of Weight Status and Dietary Behaviors of Middle School Students in Kentucky. Journal of the American Dietetic Association 107, 1139–1145. https://doi.org/10.1016/j.jada.2007.04.015

Sahoo, K., Sahoo, B., Choudhury, A.K., Sofi, N.Y., Kumar, R., Bhadoria, A.S., 2015. Childhood obesity: causes and consequences. J Family Med Prim Care 4, 187–192. https://doi.org/10.4103/2249-4863.154628

Sanchez, S., Morales, H., Alvarez, 2018. The obesity impact on fertility. Journal of Diabetes, Metabolic Disorders & Control Volume 5. https://doi.org/10.15406/jdmdc.2018.05.00146

Scaglioni, S., Salvioni, M., Galimberti, C., 2008. Influence of parental attitudes in the development of children eating behaviour. Br J Nutr 99 Suppl 1, S22-25. https://doi.org/10.1017/S0007114508892471

Scharf, R.J., DeBoer, M.D., 2016. Sugar-Sweetened Beverages and Children's Health. Annu. Rev. Public Health 37, 273–293. https://doi.org/10.1146/annurev-publhealth-032315-021528

Serra-Majem, L., Bartrina, J.A., Pérez-Rodrigo, C., Ribas-Barba, L., Delgado-Rubio, A., 2006. Prevalence and deteminants of obesity in Spanish children and young people. British Journal of Nutrition 96, S67–S72. https://doi.org/10.1079/BJN20061703

Shah, B., Cost, K.T., Fuller, A., Birken, C.S., Anderson, L.N., 2020. Sex and gender differences in childhood obesity: contributing to the research agenda. BMJ Nutrition, Prevention & Health bmjnph. https://doi.org/10.1136/bmjnph-2020-000074

Shamriz, O., Leiba, M., Levine, H., Derazne, E., Keinan-Boker, L., Kark, J.D., 2017. Higher body mass index in 16–19 year-old Jewish Adolescents of North African, Middle Eastern and European Origins is a Predictor of Acute Myeloid Leukemia: a cohort of 2.3 million Israelis. Cancer Causes Control 28, 331–339. https://doi.org/10.1007/s10552-017-0863-5

Sherry, B., Jefferds, M.E., Grummer-Strawn, L.M., 2007. Accuracy of adolescent self-report of height and weight in assessing overweight status: a literature review. Arch Pediatr Adolesc Med 161, 1154–1161. https://doi.org/10.1001/archpedi.161.12.1154

Shrime, M.G., Bauer, S.R., McDonald, A.C., Chowdhury, N.H., Coltart, C.E.M., Ding, E.L., 2011. Flavonoid-rich cocoa consumption affects multiple cardiovascular risk factors in a meta-analysis of short-term studies. J Nutr 141, 1982–1988. https://doi.org/10.3945/jn.111.145482

Sigmund, E., Sigmundová, D., Badura, P., Kalman, M., Hamrik, Z., Pavelka, J., 2015. Temporal Trends in Overweight and Obesity, Physical Activity and Screen Time among Czech Adolescents from 2002 to 2014: A National Health Behaviour in School-Aged Children Study. Int J Environ Res Public Health 12, 11848–11868. https://doi.org/10.3390/ijerph120911848

Simmonds, M., Llewellyn, A., Owen, C.G., Woolacott, N., 2016. Predicting adult obesity from childhood obesity: a systematic review and meta-analysis. Obes Rev 17, 95–107. https://doi.org/10.1111/obr.12334

Skinner, A.C., Perrin, E.M., Moss, L.A., Skelton, J.A., 2015. Cardiometabolic Risks and Severity of Obesity in Children and Young Adults [WWW Document]. https://doi.org/10.1056/NEJMoa1502821. https://doi.org/10.1056/NEJMoa1502821

Smith, K.J., Gall, S.L., McNaughton, S.A., Blizzard, L., Dwyer, T., Venn, A.J., 2010. Skipping breakfast: longitudinal associations with cardiometabolic risk factors in the Childhood Determinants of Adult Health Study. Am J Clin Nutr 92, 1316–1325. https://doi.org/10.3945/ajcn.2010.30101

Spinelli, A., Buoncristiano, M., Kovacs, V.A., Yngve, A., Spiroski, I., Obreja, G., Starc, G., Pérez, N., Rito, A.I., Kunešová, M., Sant'Angelo, V.F., Meisfjord, J., Bergh, I.H., Kelleher, C., Yardim, N., Pudule, I., Petrauskiene, A., Duleva, V., Sjöberg, A., Gualtieri, A., Hassapidou, M., Hyska, J., Burazeri, G., Petrescu, C.H., Heinen, M., Takacs, H., Zamrazilová, H., Bosi, T.B., Sacchini, E., Pagkalos, I., Cucu, A., Nardone, P., Gately, P., Williams, J., Breda, J., 2019. Prevalence of Severe Obesity among Primary School Children in 21 European Countries. Obes Facts 12, 244–258. https://doi.org/10.1159/000500436

Stamatakis, E., Wardle, J., Cole, T.J., 2010. Childhood obesity and overweight prevalence trends in England: evidence for growing socioeconomic disparities. Int J Obes (Lond) 34, 41–47. https://doi.org/10.1038/ijo.2009.217

Stea, T.H., Tveter, E.T., Velde, S.J. te, Vik, F.N., Klepp, K.-I., Bere, E., 2018. The effect of an extra piece of fruit or vegetables at school on weight status in two generations - 14 years follow-up of the Fruit and Vegetables Makes the Marks study. PLOS ONE 13, e0205498. https://doi.org/10.1371/journal.pone.0205498

Sterne, J.A.C., White, I.R., Carlin, J.B., Spratt, M., Royston, P., Kenward, M.G., Wood, A.M., Carpenter, J.R., 2009. Multiple imputation for missing data in epidemiological and clinical research: potential and pitfalls. BMJ 338, b2393. https://doi.org/10.1136/bmj.b2393

St-Onge, M.-P., Keller, K.L., Heymsfield, S.B., 2003. Changes in childhood food consumption patterns: a cause for concern in light of increasing body weights. Am J Clin Nutr 78, 1068–1073. https://doi.org/10.1093/ajcn/78.6.1068

Swinburn, B., Egger, G., Raza, F., 1999. Dissecting Obesogenic Environments: The Development and Application of a Framework for Identifying and Prioritizing Environmental Interventions for Obesity. Preventive Medicine 29, 563–570. https://doi.org/10.1006/pmed.1999.0585

Swinburn, B.A., Sacks, G., Hall, K.D., McPherson, K., Finegood, D.T., Moodie, M.L., Gortmaker, S.L., 2011. The global obesity pandemic: shaped by global drivers and local environments. The Lancet 378, 804–814. https://doi.org/10.1016/S0140-6736(11)60813-1

Szajewska, H., Ruszczynski, M., 2010. Systematic review demonstrating that breakfast consumption influences body weight outcomes in children and adolescents in Europe. Crit Rev Food Sci Nutr 50, 113–119. https://doi.org/10.1080/10408390903467514

Tambalis, K.D., Panagiotakos, D.B., Psarra, G., Sidossis, L.S., 2018. Association between fast-food consumption and lifestyle characteristics in Greek children and adolescents; results from the EYZHN (National Action for Children's Health) programme. Public Health Nutr 21, 3386–3394. https://doi.org/10.1017/S1368980018002707

Thibault, H., Contrand, B., Saubusse, E., Baine, M., Maurice-Tison, S., 2010. Risk factors for overweight and obesity in French adolescents: physical activity, sedentary behavior and parental characteristics. Nutrition 26, 192–200. https://doi.org/10.1016/j.nut.2009.03.015

Thompson, O.M., Ballew, C., Resnicow, K., Must, A., Bandini, L.G., Cyr, H., Dietz, W.H., 2004. Food purchased away from home as a predictor of change in BMI z-score among girls. Int J Obes Relat Metab Disord 28, 282–289. https://doi.org/10.1038/sj.ijo.0802538

Top Food Sources of Dietary Components | EGRP/DCCPS/NCI/NIH [WWW Document], 2019. URL https://epi.grants.cancer.gov/diet/foodsources/ (accessed 5.5.21).

Townshend, T., Lake, A., 2017. Obesogenic environments: current evidence of the built and food environments. Perspect Public Health 137, 38–44. https://doi.org/10.1177/1757913916679860

Turula, M., Kaprio, J., Rissanen, A., Koskenvuo, M., 1990. Body weight in the Finnish Twin Cohort. Diabetes Res Clin Pract 10 Suppl 1, S33-36. https://doi.org/10.1016/0168-8227(90)90137-i

Tzotzas, T., Kapantais, E., Tziomalos, K., Ioannidis, I., Mortoglou, A., Bakatselos, S., Kaklamanou, M., Lanaras, L., Kaklamanos, I., 2008. Epidemiological survey for the prevalence of overweight and abdominal obesity in Greek adolescents. Obesity (Silver Spring, Md.) 16, 1718–1722. https://doi.org/10.1038/oby.2008.247

Utter, J., Neumark-Sztainer, D., Jeffery, R., Story, M., 2003. Couch potatoes or french fries: are sedentary behaviors associated with body mass index, physical activity, and dietary behaviors among adolescents? J Am Diet Assoc 103, 1298–1305. https://doi.org/10.1016/s0002-8223(03)01079-4

Uzogara, S.G., 2017. Obesity Epidemic, Medical and Quality of Life Consequences: A Review. International Journal of Public Health Research 5, 1. https://doi.org/7180284

Wang, V.H., Min, J., Xue, H., Du, S., Xu, F., Wang, H., Wang, Y., 2018. What factors may contribute to sex differences in childhood obesity prevalence in China? Public Health Nutrition 21, 2056–2064. https://doi.org/10.1017/S1368980018000290

Wang, Y., Lobstein, T., 2006. Worldwide trends in childhood overweight and obesity. Int J Pediatr Obes 1, 11–25. https://doi.org/10.1080/17477160600586747

Wang, Z., Patterson, C.M., Hills, A.P., 2002. A comparison of self-reported and measured height, weight and BMI in Australian adolescents. Aust N Z J Public Health 26, 473–478. https://doi.org/10.1111/j.1467-842x.2002.tb00350.x

Wardle, J., Carnell, S., Haworth, C.M., Plomin, R., 2008. Evidence for a strong genetic influence on childhood adiposity despite the force of the obesogenic environment. Am J Clin Nutr 87, 398–404. https://doi.org/10.1093/ajcn/87.2.398

Weihrauch-Blüher, S., Schwarz, P., Klusmann, J.-H., 2019. Childhood obesity: increased risk for cardiometabolic disease and cancer in adulthood. Metabolism - Clinical and Experimental 92, 147–152. https://doi.org/10.1016/j.metabol.2018.12.001

Weihrauch-Blüher, S., Wiegand, S., 2018. Risk Factors and Implications of Childhood Obesity. Curr Obes Rep 7, 254–259. https://doi.org/10.1007/s13679-018-0320-0

Welker, E., Lott, M., Story, M., 2016. The School Food Environment and Obesity Prevention: Progress Over the Last Decade. Curr Obes Rep 5, 145–155. https://doi.org/10.1007/s13679-016-0204-0

Wells, J.C.K., 2007. Sexual dimorphism of body composition. Best Practice & Research Clinical Endocrinology & Metabolism, Normal and Abnormal Sex Development 21, 415–430. https://doi.org/10.1016/j.beem.2007.04.007

Wennberg, M., Gustafsson, P.E., Wennberg, P., Hammarström, A., 2015. Poor breakfast habits in adolescence predict the metabolic syndrome in adulthood. Public Health Nutrition 18, 122–129. https://doi.org/10.1017/S1368980013003509

WHO | Overweight and obesity. Facts and Figures on Childhood Obesity. [WWW Document], 2020. URL https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight (accessed 11.17.20).

WHO | Overweight and obesity [WWW Document], 2016. . WHO. URL http://www.who.int/gho/ncd/risk_factors/overweight_obesity/obesity_adolescents/en/ (accessed 9.24.20).

WHO/Europe, F. and nutrition policy for schools, 2006. Food and nutrition policy for schools: a tool for the development of school nutrition programmes in the WHO European Region [WWW Document]. URL https://www.euro.who.int/en/health-topics/disease-prevention/nutrition/publications/guidance-and-tools/school-age-children-and-adolescents/food-and-nutrition-policy-for-schools-a-tool-for-the-development-of-school-nutrition-programmes-in-the-who-european-region (accessed 1.19.21).

Wilfley, D.E., Vannucci, A., White, E.K., 2010. Early Intervention of Eating- and Weight-Related Problems. J Clin Psychol Med Settings 17, 285–300. https://doi.org/10.1007/s10880-010-9209-0

Wisniewski, A.B., Chernausek, S.D., 2009. Gender in childhood obesity: Family environment, hormones, and genes. Gender Medicine, Diabetes, Obesity, and the Metabolic Syndrome 6, 76–85. https://doi.org/10.1016/j.genm.2008.12.001

World Health Organization, 2015. Guideline: Sugars Intake for Adults and Children. World Health Organization.

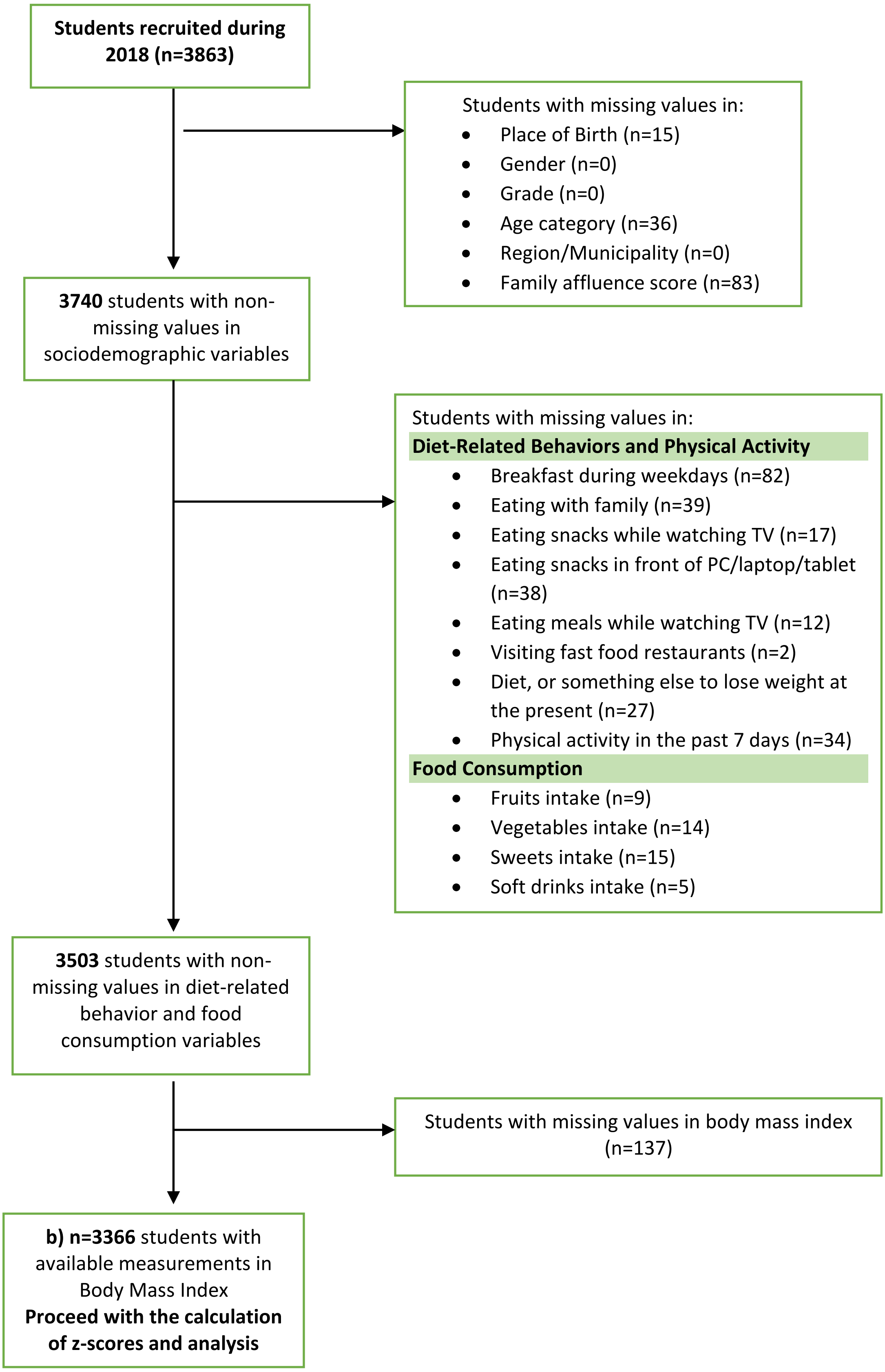
Yan, J., Liu, L., Zhu, Y., Huang, G., Wang, P.P., 2014. The association between breastfeeding and childhood obesity: a meta-analysis. BMC Public Health 14. https://doi.org/10.1186/1471-2458-14-1267

Young, L.R., Nestle, M., 2002. The Contribution of Expanding Portion Sizes to the US Obesity Epidemic. Am J Public Health 92, 246–249. https://doi.org/10.2105/AJPH.92.2.246

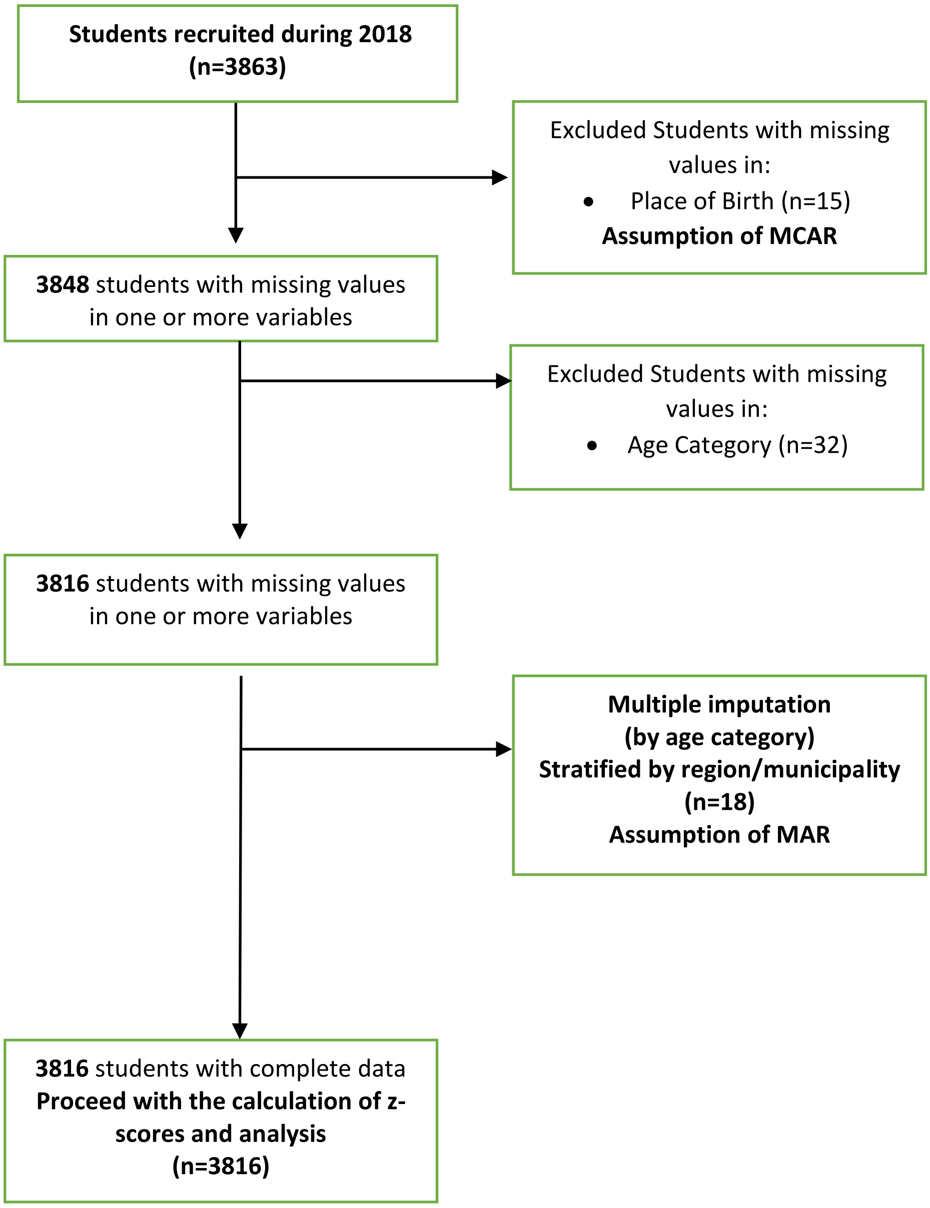
Appendix

Appendix 1

Flowchart for complete case analysis examining the association between overweight/obesity and diet-related behaviours in the Greek arm of the international health behaviour in school-aged children (HBSC) study during 2018.



Flowchart for imputed data analysis examining the association between overweight/obesity and diet-related behaviours in the Greek arm of the international health behaviour in school-aged children (HBSC) study during 2018



APPENDIX 2:

Multiple Imputation

We created 10 copies of datasets in which missing values of bodyweight, bodyheight, breakfast consumption on weekdays, family meals, family affluence score, eating snacks while watching TV, eating snacks while working/playing on a computer, watching TV while having a meal, eating in fast food restaurants, being on a diet or something else to lose weight at the present, physical activity the past 7 days, eating fruits, eating vegetables, eating sweets, drinking coke/soft drinks were replaced by imputed values sampled from their predictive distribution, through multiple imputation by chained equations, which was applied separately in 3 age groups (11-, 13-, and 15-year-old), and we created multiple copies of datasets (n=10) with imputed values. Imputation was adjusted by region/ municipality (18 categories). The imputation model in each age group included the following variables that were mutually adjusted:

Bodyweight: modelled through predictive mean matching

Bodyheight: modelled through linear regression

Breakfast consumption on weekdays: modelled through multinomial logistic regression

Family meals together: modelled through multinomial logistic regression

Family affluence score (FAS): modelled through multinomial logistic regression

Eating snacks while watching TV: modelled through multinomial logistic regression

Eating snacks while working/playing on a computer: modelled through multinomial logistic regression

Watching TV while having a meal: modelled through multinomial logistic regression

Eating in fast food restaurants: modelled through multinomial logistic regression

Being on a diet or something else to lose weight at the present: modelled through multinomial logistic regression

Physical activity the past 7 days: modelled through multinomial logistic regression

Eating fruits: modelled through multinomial logistic regression

Eating vegetables: modelled through multinomial logistic regression

Eating sweets: modelled through multinomial logistic regression

Drinking coke/soft drinks (SSBs): modelled through multinomial logistic regression

plus, the sociodemographic variables gender (sex), region/municipality, and place of birth), that had no missing data.

APPENDIX 3:

Overweight and Obesity prevalence by gender and age category from complete case analysis of 3366 participants and from the analysis performed after imputation with the total 3816 participants in the 2018 Greek-arm of the HBSC* study.

	UNDERWEIGHT		NORMALWEIGHT		OVERWEIGHT		OBESE	
	Complete case	After imputation	Complete case	After imputation	Complete case	After imputation	Complete case	After imputation
ALL AGES	**n=3366**	**n=3816**	**n=3366**	**n=3816**	**n=3366**	**n=3816**	**n=3366**	**n=3816**
TOTAL N(%)	**99 (2.9%)**	**3.5%**	**2446 (72.7%)**	**71.8%**	**647 (19.2%)**	**19.4%**	**174(5.2%)**	**5.3%**
BOYS	42 (2.6%)	3.2%	1075 (66.3%)	65.4%	392 (24.2%)	24.1%	111 (6.9%)	7.3%
GIRLS	57 (3.3%)	3.7%	1371 (78.5%)	78.2%	255 (14.6%)	14.7%	63 (3.6%)	3.4%
11-YEAR-OLDS	**n=1013**	**n=1216**	**n=1013**	**n=1216**	**n=1013**	**n=1216**	**n=1013**	**n=1216**
TOTAL	**43 (4.3%)**	**5.0%**	**695 (68.6%)**	**67.7%**	**218 (21.5%)**	**21.6%**	**57 (5.6%)**	**5.7%**
BOYS	15 (3.1%)	3.7%	314 (64.3%)	63.0%	127 (26.0%)	26.1%	32 (6.6%)	7.2%
GIRLS	28 (5.3%)	6.4%	381 (72.6%)	72.3%	91 (17.3%)	17.1%	25 (4.8%)	4.2%
13-YEAR-OLDS	**n=1173**	**n=1299**	**n=1173**	**n=1299**	**n=1173**	**n=1299**	**n=1173**	**n=1299**
TOTAL	**43 (3.6%)**	**3.9%**	**843 (71.9%)**	**71.3%**	**229 (19.5%)**	**19.9%**	**58 (5.0%)**	**4.9%**
BOYS	20 (3.6%)	4.2%	373 (67.0%)	66.2%	127 (22.8%)	23.0%	37 (6.6%)	6.6%
GIRLS	23 (3.7%)	3.5%	470 (80.0%)	76.3%	102 (16.6%)	16.8%	21 (3.4%)	3.4%
15-YEAR-OLDS	**n=1180**	**n=1301**	**n=1180**	**n=1301**	**n=1180**	**n=1301**	**n=1180**	**n=1301**
TOTAL	**13 (1.1%)**	**1.6%**	**908 (77.0%)**	**76.1%**	**200 (16.9%)**	**16.9%**	**59 (5.0%)**	**5.4%**
BOYS	7 (1.2%)	1.8%	388 (67.5%)	66.7%	138 (24.0%)	23.4%	42 (7.3%)	8.1%
GIRLS	6 (1.0%)	1.4%	520 (85.9%)	85.6%	62 (10.3%)	10.4%	17 (2.8%)	2.6%

* HBSC: Health Behaviour in School-aged Children study

APPENDIX 4:

Adjusted odds ratios (OR) and associated 95% confidence intervals (CI) from **logistic regression** model for the association of **Overweight** with diet-related and lifestyle behaviors **among 3366** participants in the 2018 Greek-arm of the HBSC study (complete cases analysis) by gender.

	ALL (n=3366)		BOYS (n=1620)		GIRLS (n=1746)	
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
Gender						
Boys	**Ref.**					
Girls	**0.60(0.30-0.43)**	**<0.001**				
Age group						
11-year-olds	**Ref.**		**Ref.**		**Ref.**	
13-year-olds	0.78 (0.63-0.97)	**0.026**	0.88 (0.65-1.20)	0.415	**0.71 (0.52-0.97)**	**0.032**
15-year-olds	0.60 (0.48-0.75)	**<0.001**	0.88 (0.63-1.24)	0.480	**0.35 (0.24-0.50)**	**<0.001**
Family Affluence scale (FAS)						
Low 20% affluence	**Ref.**		**Ref.**		**Ref.**	
Middle 60% affluence	**0.58 (0.45-0.74)**	**<0.001**	**0.66 (0.47-0.92)**	**0.013**	**0.49 (0.34-0.70)**	**<0.001**
High 20% affluence	**0.54 (0.40-0.72)**	**<0.001**	0.69 (0.48-1.01)	0.058	**0.36 (0.22-0.58)**	**<0.001**
Physical activity (past 7 days)						
0-1 days	**2.62 (1.92-3.59)**	**<0.001**	**2.18 (1.47-3.25)**	**<0.001**	**3.43 (1.99-5.91)**	**<0.001**
2-3 days	**2.07 (1.62-2.63)**	**<0.001**	**2.12 (1.57-2.85)**	**<0.001**	**2.10 (1.40-3.14)**	**<0.001**
4-5 days	**1.42 (1.12-1.81)**	**0.004**	1.32 (0.98-1.78)	0.072	**1.80 (1.19-2.73)**	**0.006**
6-7 days	**Ref.**		**Ref.**		**Ref.**	
Eating breakfast on weekdays						
Never	**1.28 (1.05-1.57)**	**0.017**	1.19 (0.89-1.58)	0.239	**1.47 (1.08-1.99)**	**0.013**
1-4 days	1.00 (0.81-1.25)	0.972	0.84 (0.64-1.11)	0.229	1.24 (0.88-1.76)	0.223
Always (5 days)	**Ref.**		**Ref.**		**Ref.**	
Family meals						
Every day	**Ref.**		**Ref.**		**Ref.**	
Almost every day	1.00 (0.82-1.22)	0.993	1.07 (0.83-1.39)	0.597	0.88 (0.62-1.24)	0.472
Rarely	1.25 (0.98-1.59)	0.071	**1.47 (1.08-1.99)**	**0.014**	1.03 (0.71-1.50)	0.870
Total score for behavior of Eating snacks/meals in front of screens (TV/PC/tablet)	1.02 (0.96-1.08)	0.556	0.94 (0.87-1.02)	0.148	**1.13 (1.04-1.23)**	**0.003**
Eating in fast-food restaurants						
Never	**Ref.**		**Ref.**		**Ref.**	
Less than once/month	1.40 (0.88-2.23)	0.161	1.79 (0.92-3.50)	0.087	1.18 (0.59-2.35)	0.644
1-3 days/month	1.02 (0.62-1.66)	0.947	1.43 (0.72-2.81)	0.304	0.71 (0.36-1.40)	0.322
Weekly	1.02 (0.61-1.69)	0.950	1.39 (0.68-2.84)	0.362	0.71 (0.34-1.49)	0.357
Fruits Intake						
Less than once/week	1.09 (0.74-1.59)	0.668	1.39 (0.82-2.35)	0.218	0.84 (0.43-1.64)	0.616
1-4 days/week	1.11 (0.90-1.38)	0.330	1.05 (0.77-1.41)	0.772	1.26 (0.91-1.74)	0.170
5-6 days/week	0.96 (0.75-1.22)	0.715	0.72 (0.52-1.01)	0.059	1.47 (1.00-2.18)	0.053
Every day	**Ref.**		**Ref.**		**Ref.**	
Vegetables Intake						
Less than once/week	1.03 (0.76-1.40)	0.840	0.88 (0.57-1.34)	0.539	1.35 (1.79-2.30)	0.272
1-4 days/week	1.06 (0.85-1.31)	0.606	0.87 (0.65-1.17)	0.360	1.37 (0.94-2.00)	0.099
5-6 days/week	0.98 (0.78-1.22)	0.823	0.78 (0.58-1.05)	0.104	1.35 (0.92-1.99)	0.122
Every day	**Ref.**		**Ref.**		**Ref.**	
Sweets Intake						
Less than once/week	**Ref.**		**Ref.**		**Ref.**	
1-4 days/week	1.03 (0.81-1.30)	0.819	0.99 (0.74-1.34)	0.964	1.23 (0.80-1.88)	0.346
5-6 days/week	1.07 (0.77-1.51)	0.676	0.89 (0.59-1.35)	0.590	1.56 (0.90-2.70)	0.112
Every day	0.78 (0.54-1.14)	0.198	0.68 (0.42-1.09)	0.111	1.03 (0.61-1.73)	0.923
Sugar-sweetened beverage intake						
Less than once/week	**Ref.**		**Ref.**		**Ref.**	
1-4 days/week	1.11 (0.92-1.34)	0.258	1.02 (0.80-1.31)	0.870	1.17 (0.88-1.55)	0.272
>5 days/week	1.25 (0.89-1.76)	0.189	1.33(0.86-2.04)	0.194	1.04 (0.60-1.81)	0.880
Diet or other patterns to lose weight						
No	**Ref.**		**Ref.**		**Ref.**	
Yes	**4.56 (3.71-5.62)**	**<0.001**	**4.63 (3.43-6.25)**	**<0.001**	**5.35 (3.93-7.28)**	**<0.001**

Thank you!