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EFFECT OF TELEVISION VIEWING ON FOOD AND NUTRIENTS INTAKE AMONG ADOLESCENTS

Porto 2010

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ABREVIATIONS LIST

BMI – body mass index

DALYs - disability-adjusted life-years

DASH - Dietary Approaches to Stop Hypertension

EPITeen - Epidemiological Investigation of Teenagers Health in Porto

FFQ - food frequency questionnaire

g – grams

HBSC – Health Behaviour in School-Aged Children

Kcal – Kilocalories

LDL – low density lipoprotein

mg – milligrams

NCDs - non-communicable diseases

NHANES – National Health and Nutrition Examination Survey

POR – proportional odds ratio

TV – Television

US – United States

WHO – World Health Organization

RESUMO

Introdução: A adolescência é a oportunidade para preparar uma vida adulta saudável e para promover a prática de exercício físico e hábitos alimentares saudáveis. Adicionalmente, a adolescência constitui um período particularmente vulnerável em termos nutricionais dadas as necessidades para o crescimento e desenvolvimento. Entre os comportamentos relacionados com a ingestão alimentar, o tempo a ver televisão é particularmente importante dada a quantidade de adolescentes expostos. Além disso, o tempo elevado a ver televisão nos adolescentes tem sido associado com inactividade física e com hábitos alimentares menos saudáveis.

Objectivo: Foi desenhada uma avaliação transversal com o objectivo de avaliar a associação entre o tempo a ver televisão e a ingestão alimentar em adolescentes de 13 anos. Analisámos, de acordo com o tempo a ver televisão, a ingestão de alimentos (bolos, bolachas, refrigerantes, chocolates, snacks de chocolate, rebuçados, pizza, hambúrguer, snacks salgados e fruta e vegetais) e a ingestão de macronutrientes, vitaminas e minerais.

Métodos: O presente estudo foi desenvolvido no âmbito do projecto EPITeen. Integraram o estudo as 27 escolas públicas e 19 das 24 escolas privadas contactadas. Foram identificados 2787 adolescentes elegíveis, nascidos em 1990 durante o ano escolar de 2003/2004. Não foi possível contactar 44 adolescentes (1.6%) e 583 (20.9%) não devolveram a declaração de consentimento assinada, pelo que foram considerados recusas. Participaram no estudo 2160 adolescentes (1651 inscritos em escolas públicas e 509 em privadas). A proporção de participação foi 77.5%, semelhante em escolas públicas e privadas (77.7% vs 77.0%, p=0.71). Após exclusão dos participantes com informação incompleta e com uma ingestão energética total superior a 3 desvios inter-quartil ou uma ingestão de fruta ou vegetais superior a 1.5 desvio inter-quartil, a amostra final incluiu 1436 adolescentes (765 raparigas e 671 rapazes).

As informações sobre características comportamentais, sociais e demográficas, história pessoal e familiar de doença, foram recolhidas utilizando dois questionários estruturados e foi realizada uma avaliação física na escola.

A ingestão alimentar foi avaliada através de um questionário de frequência alimentar.

A avaliação antropométrica incluiu a medição do peso e da estatura. Para determinar os percentis de índice de massa corporal, foram utilizados os percentis de referência para o sexo e a idade, desenvolvidos pelo *Centers for Disease Control and Prevention*.

Resultados: Em ambos os sexos, as escolas públicas apresentaram uma proporção significativamente maior de adolescentes que vêem mais de 2 horas de televisão por dia e a média de escolaridade dos pais é menor no grupo que vê mais horas de televisão. Não foram encontradas diferenças estatisticamente significativas em relação ao índice de massa corporal. As raparigas que vêem mais de 2 horas de televisão por dia referiram uma menor prática de desporto.

Os adolescentes que vêem mais de 2 horas de televisão por dia apresentaram uma ingestão significativamente superior de gordura total e polinsaturada e uma menor ingestão de magnésio, em ambos os sexos. Adicionalmente, nas raparigas, ver mais de duas horas de televisão por dia foi associado a uma menor ingestão de hidratos de carbono complexos, fibras, vitamina A total, folato, vitamina C, cálcio, ferro, fósforo e potássio. Nos rapazes que vêem mais de duas horas de televisão por dia foi encontrada uma maior ingestão de gordura saturada e colesterol.

Conclusões: O tempo a ver televisão está associado com uma maior ingestão de alimentos com elevado teor de gordura e açúcar e uma menor ingestão de fruta e vegetais. Consequentemente, os adolescentes que vêem mais horas de televisão por dia apresentam uma maior ingestão de gordura total e polinsaturada e menor ingestão de minerais e vitaminas. Este comportamento alimentar entre adolescentes poderá ter implicações na saúde a longo prazo.

ABSTRACT

Introduction: Although a generally healthy period, adolescence is the opportunity to prepare for a healthy adult live, and to promote the practice of physical activity and healthy eating habits. Additionally, adolescence is a period of potential nutritional risk given the nutritional requirements for growth and development. Among the behaviours that were associated with food intake, exposure to television is particularly important given the amount of adolescents exposed. Also, increased time spent watching television (TV) has been associated with physical inactivity and with less desirable dietary intake among adolescents.

Objective: We designed a cross-sectional survey to examine the association between television viewing and dietary intake, among 13-year-old adolescents. We analyse, according to time spent watching TV, food intake (cakes, cookies, soft drinks, chocolates, snacks of chocolate, sweets, pizza, hamburger, salty snacks and fruit and vegetables) and macronutrients, vitamins and minerals intake.

Methods: The present study was part of the EPITeen cohort. In the compliant schools (all 27 public schools and 19 private schools) we identified 2787 eligible adolescents born in 1990 during the 2003/2004 school year. Forty-four (1.6%) could not be reached always missing classes during the study period and 583 (20.9%) did not return the signed informed consent form and were considered refusals. Information, at least for part of the planned assessment, was provided by 2160 adolescents (1651 public and 509 private schools students). The overall participation proportion was 77.5%, similar in public and private schools (77.7% vs 77.0%, p=0.71). After exclusion of participants with incomplete information and with a total energy intake above 3 interquartile deviations or an intake of fruit or vegetables above 1.5 interquartile deviations, the final sample includes 1436 students (765 girls and 671 boys).

Data on behavioural, social, demographic and clinical characteristics was collected by two self-administered questionnaires and a physical examination was performed. Dietary intake was evaluated using a food frequency questionnaire.

Anthropometric evaluation included weight and height measurements. The age and sex specific body mass index (BMI) references developed by the Centers for Disease Control and Prevention were used to assign BMI percentiles.

Results: In both genders, public school presented a significant higher proportion of adolescents that watched more than 2 hours of TV per day, also the mean parent's education of adolescents that watched TV more time was lowest. No statistically significant differences were found according to body mass index. Girls that watched more than 2 hours of TV per day reported less practice of sports.

Spending more than 2 hours per day watching TV was significantly associated with higher intake of total fat and poly-unsaturated fat and was associated with lower intake of magnesium, in both genders. In addiction, in girls, spending more than 2 hours per day watching TV was associated with lower intake of complex carbohydrates, fiber, total vitamin A, folate, vitamin C, calcium, iron, phosphorus and potassium. In boys, higher intake of saturated fat and cholesterol was found among those with watching TV more time.

Conclusions: We found that television viewing is associated with higher consumption of higher-fat and sugar food and less fruit and vegetables. Consequently, adolescents that watched more television presented higher intake of total fat and poly-unsaturated fat and lower intake of minerals and vitamins. This dietary behaviour among adolescents may have long-term health implications.

1. INTRODUCTION

Adolescent is someone between 10 and 19 years of age, as defined by the World Health Organization (WHO) (1). One in every five people in the world, approximately 1.2 billion, is an adolescent (2). They have survived the diseases of early childhood, have a low incidence of infections such as pneumonia and gastroenteritis compared with younger children, and the clinical health problems associated with ageing are still many years away. Nevertheless, the World Health Organization estimated that 1.4 million deaths occur, each year, among 10-19 year olds due to road traffic accidents, complications during pregnancy and child birth, suicide, violence, and HIV/AIDS (3). In Portugal, in 2006 the death rate in the 15 to 24 years old group was 44.2 per 100,000 males and 9.4 per 100,000 females, most of this due to the mortality rate related to traffic accidents (22.4 and 4.3 per 100,000, respectively) (4).

In the adult population, the population aging leads to a continuous increasing in the burden of chronic diseases, mainly cardiovascular diseases, cancers, diabetes and chronic respiratory diseases (5). In 2005 these diseases caused an estimated 35 million deaths, which represents 60% of all deaths worldwide (5). It has been projected that, by 2030, chronic disease will account for almost 70% of all deaths. Global cancer deaths are projected to increase from 7.1 million in 2002 to 11.5 million in 2030, and global cardiovascular deaths from 16.7 million in 2002 to 23.3 million in 2030 (6). These deaths cause major impact in both health and socioeconomic systems, and often follow long standing impaired quality of life, disability and suffering. Cardiovascular diseases are at this moment and will continue to be the major contributor to the global burden of disease among the non-communicable diseases (NCDs).

Moreover, chronic diseases are largely preventable diseases (7). Up to 80% of heart disease, stroke, and type 2 diabetes and over a third of cancers could be prevented by eliminating shared risk factors, mainly tobacco use, unhealthy diet, physical inactivity and use of alcohol (7). Beyond the appropriate medical treatment for those already affected, the public health approach of primary prevention is considered to be the most cost-effective,

affordable and sustainable course of action to cope with the chronic disease epidemic worldwide (7).

There is increasing evidence that chronic disease risks begin in fetal life and continue into old age (8). For instance, atherosclerosis constitutes an important contributor to cardiovascular diseases and despite the clinical outcome of the atherosclerosis being usually detected only in adult life, this process begins early in life (9-10). The lag-time effect of risk factors for cardiovascular disease means that the full effect of exposure to behavioural risk factors during childhood and adolescence will only be seen in the future. Adult chronic disease, therefore, reflects cumulative differential lifetime exposures to damaging physical and social environments. From the above, it is clear that risk factors must be addressed throughout the life course.

There is a continuity in the influences contributing to chronic disease development, and thus also to the opportunities for prevention. For chronic diseases, risks occur at all ages, conversely, all ages are part of the continuum of opportunities for their prevention and control (7).

There are critical aspects of adolescence that have an impact on chronic diseases as the development of risk factors that tend to stay throughout life. Although a generally healthy period, adolescence is the opportunity to prepare for a healthy adult live, and promote the practice of physical activity and healthy eating habits and prevent risky behaviours like smoking, use of alcohol and drugs and obesity.

1.1 DIET AND HEALTH

Nutrition is coming to the fore as a major modifiable determinant of chronic disease, with scientific evidence increasingly supporting the view that alterations in diet have strong effects, both positive and negative, on health throughout life (7). There are five important points of study and intervention, namely: obesity and energy balance; fruit and vegetables

intake; specific nutrients intake, such as fat; specific minerals intake, such as calcium; and dietary patterns.

A chronic disease that frequently starts during childhood and adolescence and have a very important burden in morbidity during life is overweight and obesity. Obesity is the result of an imbalance of energy intake and expenditure. Thus, any factor that raises energy intake or decreases energy expenditure by even a small amount will cause obesity in the long-term (11). Pediatric obesity is likely to be a major cause of ill in adulthood, but also contributes substantially to illness in childhood (12). Elevated pediatric body mass index (BMI) is associated with numerous consequences including high blood pressure (13), atherosclerosis (9), left ventricular hypertrophy (14), sleep apnea (15), asthma (16), polycystic ovarian syndrome (17), type 2 diabetes (18), gastroesophogeal reflux (19), constipation (20), and orthopedic complications (21). Obesity during the adolescence is also an important predictor of adult obesity, with an associated raised risk of disease and premature mortality (22-25). More than 60% of children who are overweight before puberty will be overweight in early adulthood, which is of particular concern as it will probably reduce the average age at which NCDs become apparent, thus greatly increasing the burden on health services which will have to provide treatment during much of their adult life. Excess body weight is responsible for more than 1 million deaths and the loss of 12 million disability-adjusted life-years (DALYs) in the WHO European Region every year. This and obesity are responsible for about 80% of adult cases of type 2 diabetes, 35% of cases of ischaemic heart disease and 55% of cases of hypertensive disease among adults. Obesity also has a negative effect on psychosocial health and personal quality of life (26).

The importance of fruit and vegetables consumption is largely recognized and since 1990 the World Health Organization recommends a minimum consumption of 400g/day, corresponding approximately to 5 portions of fruit or/and vegetables per day (27), being that the consumption of vegetables should be higher than the fruit. According to *World Health Report 2002*, low fruit and vegetables intake is estimated to cause about 19% of gastrointestinal cancer, 31% of ischaemic heart disease and 11% of stroke worldwide.

Overall, 2.7 million deaths and 26.7 million DALYs are attributable to low fruit and vegetable intake. Of the burden attributable to low fruit and vegetables intake, about 85% was from cardiovascular diseases and 15% from cancers (28). Results of a meta-analysis of cohort studies indicate that fruit and vegetables consumption is inversely associated with the occurrence of coronary heart disease (29). Accordingly, the risk of coronary heart disease is decreased by 4% for each additional portion per day of fruit and vegetables and by 7% for fruit consumption (29).

Certain dietary patterns can have substantial effects on coronary heart disease risk factors such as blood pressure in adults. The effects of increased fruit and vegetables consumption on blood pressure alone and in combination with a low-fat diet, were assessed in the Dietary Approaches to Stop Hypertension (DASH) trial. While the combination diet was more effective in lowering blood pressure, the fruit and vegetables diet also lowered blood pressure (by 2.8 mmHg systolic and 1.1 mmHg diastolic) in comparison to the control diet. Such reductions, while seeming modest at the individual level, would result in a substantial reduction in population wide risk of cardiovascular diseases by shifting the blood pressure distribution (30).

The protective effect of fruit and vegetables intake was also found in a cohort study from childhood to adulthood indicated that higher intake of vegetables in childhood was associated with lower risk of stroke death (31). In this cohort was also found that an increase in fruits intake was associated with decrease risk of cancer over a 60-years period (32).

The possible effects of fruit and vegetables may be by the protective effect of their constituents such as fiber, potassium, folate, vitamins, and other phenolic compounds (28). A combination of antioxidants and phytochemicals found in fruit and vegetables might promote health by combating free radicals, which are linked with early phase development of some chronic diseases (33). Dietary fiber is an important component of diet and essential for the proper functioning of the body. There are multiple health benefits of consuming fiber, namely, promotion of normal laxation and prevention of gastrointestinal disorders, weight control,

protection against cardiovascular disease risk factors, reduction of risk of diabetes and preventing some types of cancer (34-38).

Dietary fat is one of the most frequently studied components of diet. The role of dietary fat in chronic disease has been the focus of a large number of experimental and epidemiological studies. In general, high intake of fat is associated with a greater risk of developing cardiovascular disease such as coronary heart disease and stroke mainly through the atherogenic effects of plasma lipids (serum total cholesterol and LDL-cholesterol). The effects of dietary fats on thrombosis and endothelial function as well as the relationship of plasma and tissue lipids to the pathways of inflammation have been more recently understood. Similarly, the effects of dietary fats on blood pressure have also become more evident through observational and experimental research (39-40). Nevertheless we be aware that not all dietary fat have de same role and not all are risk factors for disease. If on one hand, the risk associated with intake of trans is clear, the role of others fats, such as unsaturated fat, especially omega-3 fatty acids, remains in discuss (41).

Although cancer and cardiovascular diseases are the diseases with a major impact on mortality, osteoporosis is currently one of the diseases with the greatest impact on morbidity of the adult population. Peak bone mass, which happens close to the adolescence (42), is a major determinant of the risk of fracture due to osteoporosis since the mass of bone tissue at any time during adult life is the difference between the amount accumulated at maturity and that lost with ageing (43). While several nutrients are important for achieving good levels of bone mass during adolescence, including calcium, phosphorus magnesium, potassium, sodium, fluoride, and vitamins A, C, D and K (44-45) about 80 to 90% of bone mineral content is composed of calcium and phosphorus and calcium is the main nutrient (46). Even thought there is controversy as to the existence of a significant association between calcium intake and dairy products and bone mass in children and adolescents (47), is recommended an adequate calcium intake, particularly from dairy products during adolescence for the attainment of peak bone mass (46).

Many studies have evaluated the associations between food groups, foods, or nutrients and chronic diseases, but in the last years interest has concentrated on dietary patterns, because they can accommodate the complex interplay of nutrients within a diet. The study of dietary patterns addresses the effect of diet as a whole and thus may provide insight beyond the effects described for single nutrients and foods. The most studied dietary pattern is the Mediterranean diet. This dietary pattern may play a beneficial role in health and longevity (48) and has been associated with a decrease in overall mortality in several studies (49-54).

1.2 ADOLESCENT DEVELOPMENT

Adolescents are in the process of establishing responsibility for their own health-related behaviours. Many of these behavioural patterns are developed during adolescence, such as physical activity and eating habits, and persist into adulthood.

The second decade of live is a period of great physical, emotional and psychological change, accompanied by biological developments characterized by evolving growth and maturation. It is, as well, a period of great changes in social interactions and relationships (3). Maturation refers to stages of progress towards the mature biological state and it is most often considered in the context of secondary sex characteristics or skeletal age. The norm for timing of maturation in human is large. The average onset for pubertal development occurs generally at 11 years old for females and 13 years old for males, but individual variation within the same sex can be wide (55-56). Despite this variability, adolescence may be divided into three developmental stages based on physical, psychological and social changes: early, middle and late adolescence (57).

Early adolescence is characterized by the developmental tasks of physical and cognitive maturation, emotional expressiveness, increased need for belonging and peer membership and experimentation with social relationships. Body image is of great concern as is a preoccupation with normality. This phase is also characterized by concrete thinking – namely

an inability to see beyond the immediate or to deal with remote, future or hypothetical problems (58).

In middle adolescence, the developmental tasks and physical changes tend to become more settled with an emphasis on emotional control, intimacy, moral development, social justice and spirituality. The focus is also on improving appearance and attractiveness, and socializing occurs in mixed-sex peer groupings, if culturally appropriate. It is during this phase of adolescence that more realistic career goals are considered and limitations recognized (58).

Late adolescence sees an increased involvement in acquiring the practical skills necessary for functioning independently of parents, making critical decisions related to adult life, as well as consolidating a moral code and socio-political ideology. (58).

The increasing autonomy of adolescents and the beginning of the separation from parents makes them more susceptible to peers and social influences and one expression of adolescents' search to establish themselves as autonomous members of society is through a change in eating habits (59). With increasing age, adolescents' personal choices and preferences gain priority over eating habits acquired in the family, and they have progressively more control over what they eat, when and where (60-61). For these reasons, adolescents are an ideal target for nutrition education. In younger children, parents are in charge and need to be influenced, in adults, it may be more difficult to modify well-established patterns. Furthermore, adolescents may not only adopt healthy eating patterns and lifestyles for themselves, but also influence their peers, family and other community members (59). Many eating habits are developed during adolescence and will last for life and habits learned in childhood and adolescence will be carried over into adulthood when they will be more difficult to change (59).

1.3 NUTRITION IN ADOLESCENCE

Adolescents are a nutritionally vulnerable group for a number of specific reasons, including their high requirements for growth, their eating patterns and lifestyles, their risk-taking behaviours and their susceptibility to environmental influences.

Inadequate nutrition in adolescence can potentially retard growth and sexual maturation, although these are likely consequences of chronic malnutrition in early infancy and childhood (59). The World Health Organization recognized protein-energy malnutrition, iron, iodine, vitamin A, folate, and calcium deficiencies as the main nutritional issues of adolescents. The effects of this deficiencies in adolescents, and others nutrition-related disorders such as obesity, may have consequences during adolescence or further increase chronic disease risk later on in adulthood (59).

Obesity is globally increasing in children and adolescents (62-63). Since 1980, the prevalence of BMI for age at or above the 95th percentile has tripled among United States (US) school-age children and adolescents, and it remains high at approximately 17% (64-66). In 9-year-old children the mean body mass index increased of 2.3 kg/m^2 form 1970 to 2002 (67). According with National Health and Nutrition Examination Survey (NHANES) 2007-2008, 18.1% of 12- through 19-year-old adolescents were at or above the 95th percentile of BMI for age, 19.3% among boys and 16.8% among girls. Based on the adult definition of obesity (BMI≥30), in 2007-2008, 12.6% of adolescents aged 12 through 19 years were obese (68). Data from Health Behaviour in School-aged Children (HBSC) shows that the prevalence of obesity and excess body weight ranges from 6% to 31% in 13-year-olds and from 6% to 30% in 15-year-olds. On average, the prevalence of obesity and excess body weight in 13-year-olds is 16% among boys and 10% among girls, and 17% and 10% among 15-year-olds, respectively. In this study, the prevalence among Portuguese adolescents was 13% for girls and 18% for boys. A high prevalence of obesity has already been described in EPITeen cohort, in which inserts this investigation (69). Using WHO criteria, the prevalence of overweight was 9.2% in girls and 11.3% in boys, and an additional 16.0% girl and 16.9%

boys were at risk of overweight. When using the International Task Force recommendations, the prevalence of obesity was 5.7% in girls and 6.6% in boys and the prevalence of overweight was 18.8% in girls and 20.8% in boys (69).

The rapid physical growth that happens during adolescence creates an increased demand for energy and some nutrients (70-71) such vitamins and minerals. Nevertheless, in last decades, significant changes have occurred in adolescent's food consumption and in general to an adverse pattern. These include a decreased in consumption of fruit and vegetables and dairy products, along with insufficient consumption of micronutrients such as calcium and some vitamins. Besides, there is an excess of consumption of fat, saturated fat, trans fats, added sugars and sodium (72).

These changes may be a result of a change of eating patterns among adolescents, such as, a reduction in regular breakfast consumption, an increase in consumption of soft drinks and foods prepared away from the home, an increase in the percentage of total calories from snacks and an increase in consumption of fried and nutrient-poor foods (70, 73).

Results in a series of cross-sectional studies in developed industrialized countries show that despite high levels of fat intake, particularly saturated, we are seeing a downward trend in consumption over the years and with age (74-75). Compared with other developed countries, adolescents in this sample have a lower fat intake, particularly saturated fat (76).

As previous said, fruits and vegetables are important sources of vitamins, minerals, phytochemicals and fibre, and this inadequate intake has a tremendous impact on the intake of these nutrients. Nutritional surveys show that children and adolescents are not meeting the recommendation to a minimum consumption of 5 portions of fruit or/and vegetables per day (77-80). Data from the HBSC study 2005-2006 shows that 35% of 13-year-old adolescents eat fruit daily, and 32% eat vegetables each day (78). However, adolescent's fruit and vegetables intake decreased with their increasing age (78, 81-82), consumption of fruit and vegetables decreased from 11 to 15 years old among boys and girls (78). Consistently, Larson et al found that adolescents decreased their daily intake of fruit and

vegetables during the transition from early to middle and from middle to late adolescence (81).

Another factor there is becoming less frequent with increasing age is breakfast consumption. Regular breakfast consumption can have a multitude of positive health benefits (83). Breakfast consumption is important to overall dietary quality and nutritional adequacy among children and adolescents (84-85) and children who report eating breakfast on a regular basis tend to have better nutritional profiles than their breakfast skipping peers (83). Taking a complete and well-balanced breakfast avoids hunger feelings in the morning which can lead to nibbling snack foods, particularly those high in sugar and/or fat (86). However, breakfast skipping among children and adolescents is highly prevalent, particularly in later adolescence (70, 83, 87). The breakfast-skipping prevalence reported in several studies ranged from 10% to 30%, depending on age group, population, and definition (83). Breakfast skipping among young people has been shown to be associated with an increased likelihood of being overweight or obese (88).

Although adolescence is a time of high calcium requirements (71), several studies suggest that children and adolescents diets are often inadequate in calcium (89-92). The frequency of an inadequate dietary calcium intake in Portuguese 7-9 years-old children was high, 35.4% vs 33.0%, for girls and boys, respectively (92) and also at 13-year-old it is expected to be higher (76).

Some researchers have argued that this insufficient intake of calcium results exist because soda intake may displace more nutritious beverages, such as milk and fruit juice, and nutrients associated with these beverages. They arguments are based on data showing that while consumption of milk has significantly decreased, adolescent's intake of soft drinks has increased in recent decades (93-95). And because beverage patterns, characterized by high levels of soda intake, have been negatively associated with children's diet quality (93, 96). Harnack and colleagues (93), in analyzing Continuing Survey of Food Intakes by Individuals data (1994-1996), found that children who consumed more soda consumed less milk and fruit juice, and had lower mean intakes of nutrients related to milk and fruit juice. Fiorito et al.

(97), in a prospective analysis among girls ages 5 to 15, revealed that relative to girls who were not consuming soda at age 5 years, girls who consume soda at age 5 had higher subsequent soda intake, lower milk intake, higher intake of added sugars, and lower intakes of protein, fiber, vitamin D, calcium, magnesium, phosphorous, and potassium from age 5 to 15 years.

The increasing autonomy that is characteristic of the adolescence allow that adolescents beginning to buy and prepare more food for themselves. One prevalent dietary pattern among adolescents that might contribute to the unhealthy food intake is the shift away from home-prepared food. Consumption by 12- to 17-year-old adolescents of food prepared away from home increased from 20% and 22% of total energy intake in boys and girls, respectively, in the 1970s to 35% of total energy intake between 1994 and 1996 (98). The vast amount of this increase has resulted from a more than doubling of the energy consumed at restaurants and fast food establishments (99). Away-from-home foods might encourage higher energy and fat intake than at-home foods because of larger portion sizes, that have been increasing both in pre-packaged, ready-to-eat products and at restaurants (100) and is associated with poorer diet quality among adolescents (101). An important reason to this relation may be the popular use of fast food for meals or snacks especially among adolescents. Fast-food was associated with significantly lower intake of fruit, vegetables, grains and serving of milk, and with significantly higher intake of soft drinks, cheeseburgers, pizza and French fries (101). Consequently, adolescents who frequently eat fast food consume more energy, total fat and saturated fat, more total carbohydrates and added sugars and less calcium, vitamin A and fiber (101-102).

Also, snacking incidence among children and adolescents has increased over the last 25 years (103). Energy intake from snacks has increased by 30% among US children and adolescents in the last few decades, accounting for a quarter of total energy intake (103). The effect of snacking on dietary intakes has been examined but results are contradictory. Some studies have shown snacking to be beneficial in meeting nutrient needs (104), others

have shown it to lower the nutrient density of the total diet (105). Thus it is unclear how this phenomenon impacts the overall quality of the diet.

Because of the extent of the eating patterns changes taking place among adolescents, early interventions are relevant due the tracking of behaviors throughout life which makes more difficult changing habits later in life (59).

1.4 PYSICAL ACTIVITY AND SEDENTARY BEHAVIOURS

On the other hand, an active lifestyle during childhood and adolescence can play an important role in optimizing growth and development. It is also a determinant of health in adulthood (23, 106).

The global estimate for prevalence of physical inactivity among adults is 17%, ranging from 11% to 24% across WHO sub-regions. Estimates for prevalence, of some, but insufficient activity (<2.5 hours per week of moderate activity) ranged from 31% to 51%, with a global average of 41% across the same sub-regions. Overall physical inactivity was estimated to cause 1.9 million deaths (28).

Children establish a sedentary lifestyle at a young age (107), and the level of physical activity tends to fall significantly at the time of adolescence. This is true for both gender, however it had a major effect on girls (108-110). Recently, an expert panel conducted a comprehensive review of the literature on physical activity in school-age youth and recommended that children and youth participate in ≥60 minutes per day of physical activity that is developmentally appropriate, enjoyable, and involves a variety of activities (111). The panel's report suggested that the ≥60 minutes can be accumulated throughout the day in school, during physical education and recess breaks, during intramural sports, and in before-school and after-school programs (111). Data from Portugal shows that only 8% of girls and 21% of boys of 13-years-old reported at least one hour of moderate-to-vigorous activity daily (78).

Associated with decreased levels of physical activity are increased levels of sedentary activities, such as television viewing (112). Time spent watching TV appear to be associated

with obesity among children and adolescents in several epidemiologic studies (112-115). Furthermore, reducing television viewing has reduced weight gain and prevalence of obesity in experimental trials (113, 116). The most discuss mechanisms by witch television viewing contributes to obesity are the reducing energy expenditure, not only because it is a sedentary activity but also for the displacement of physical activity, and the increasing dietary energy intake (113).

The effect on dietary energy intake may be due to snaking during viewing or from increased highly advertised food intake (113). Previous studies demonstrating that TV viewing is associated with less desirable dietary behaviours, including increased energy intake (112, 115, 117-118), increased consumption of high-energy foods like snacks, fast-food and soft drinks (101, 117, 119-123), and lower consumption of fruit and vegetables (117, 119-121, 123-124). Only a few studies have examined the association between television viewing and nutrients intake. Utter et al. found that adolescents in the high television/video category were significantly more likely to consume a higher percent of fat energy than the average and lower users (117). Data from other study also found significantly higher consumption of total fat among children who watching TV more than 2 hours per day. Moreover, it was observed that 1 hour per day increase in TV viewing time is associated with 0.22% of total energy intake increase in total fat (118). Nevertheless, Proctor et al. reported no differences in fat, carbohydrates, proteins, vitamin A, magnesium and calcium intake among children (115).

Others studies have been addressing not only in time spent watching TV but also in the relationship between the presence of television at meals and children (125) and adolescents (126) food consumption patterns. Watching TV during family meals was also associated with lower intakes of fruit, vegetables and dairy products and higher intakes of soft drinks, meat, pizza and snacks among children and adolescents.

Advertising broadcast is another variable that can explain the effect of television on dietary energy intake. Television food advertisements have been linked to children's food preferences (127-128). An experiment with children showed that only a brief exposure to

food advertisements embedded within children's programming resulted in the children choosing the advertised brand of food over a similar unadvertised product (128).

Several content analyses of children and adolescent's television programs showed that foods, especially high-fat or high-sugar foods, are more frequently advertised (127, 129-130). Powell et al. examined the nutritional content of food advertisements seen by children and adolescents and found that 97.8% of all food-product advertisements viewed by children 2 to 11 years old were unhealthy, being either high in fat, sugar, or sodium. Among the food advertisements seen by children 2 to 11 years old, almost all (97.6%) cereal products were high in sugar, and the majority (78.6%) had low fiber content. Sweets were not only high in sugar (88.6%), but almost one half (47.4%) were high in saturated fat. Almost two thirds of advertised snacks were high in sugar, with over one third being high in fat and one quarter being high in saturated fat. Virtually all beverage advertisements (99.5%) were for high-sugar beverages. Compared with the advertisements viewed by their younger counterparts, products in advertisements seen by adolescents for food in general and within each food category were more likely to be high in fat, whereas slightly less likely to be high in sugar. Just less than three quarters of all food advertisements seen by adolescents were high sugar food products, whereas one quarter were high in fat and high in saturated fat. In particular, among sweets and snack products, 46.3% and 45.1%, respectively, of food advertisements were high in fat (129). Data from Portugal show that sugar products (67%) were the dominant food subcategory of advertisements targeted to child/adolescent public and 86% of the total food products advertisements could not be included in the *Nova Roda dos Alimentos* (130).

Besides this issue of food advertising, watching TV is also an important predictor of cognitive, behavioural, and physical outcomes in children and adolescents, including school performance (131), bullying (132) and attention (133). Accordingly, the American Academy of Pediatrics currently recommends limiting children's television watching to no more than 2 hours of quality programming per day (134). However, a systematic review suggests that young people watch approximately 1.8-2.8h of television per day and, although TV viewing

decreases during adolescence, the earlier high users are at risk to maintain this pattern to older ages (135). Results of the 2005-2006 HBSC study indicate that 70% of 13-year-old adolescents report watching TV more than 2h each day in WHO European regions. In Portugal, 82% of girls and 76% of boys reported watching more than 2 h per day (78).

2. AIMS

The present study was carry on during the assembling of a cohort of urban adolescents born in 1990 enrolled at schools in Porto, known by the acronym EPITeen (Epidemiological Investigation of Teenagers Health in Porto). We designed a cross-sectional survey to examine the association between television viewing and dietary intake, among 13-year-old adolescents.

The specific objectives of this thesis were: to analyse food intake (cakes, cookies, soft drinks, chocolates, snacks of chocolate, sweets, pizza, hamburger, salty snacks and fruit and vegetables) and macronutrients, vitamins and minerals intake, according to time spent watching TV.

3. PARTICIPANTS AND METHODS

The EPITeen research project was designed to study growth, development and health in a population-based cohort of urban adolescents, from 13 years of age until young adulthood (69). The study addresses four primary areas of research: (1) growth and physical development; (2) behavioural and biological risk factors; (3) prevalence of selected diseases with large public health impact; and (4) psycho-social measures. It also aims to provide information for a comprehensive understanding of the tracking of risk factors and their effects on adulthood health.

The EPITeen study was approved by the ethics committee of the São João University Hospital, Porto and by *Direcção Regional de Educação do Norte*, the official entity that provides general orientation and regional policies for all schools in Porto. Policies and procedures were developed to guarantee data confidentiality and protection and written informed consent was obtained both from the adolescents and their parents or legal guardians.

The executive boards of every Porto school attended by 13-year-old adolescents (27 public and 24 private) were contacted. All public schools and 19 private schools (79%) agreed to participate.

The sample included adolescents born in 1990 and enrolled at public and private schools in Porto, during 2003/2004.

Approximately 200 eligible students were present in non-participating schools but no effort was made to contact them using alternative approaches. We identified 2787 eligible adolescents. Forty-four (1.6%) could not be reached due to absences during period of evaluation, 584 (20.9%) did not return the signed informed consent form and were considered refusals, and 2160 (1651 public and 509 private schools students) agreed to participate and provide information at least for part of the planned assessment. The overall participation proportion was 77.5%, similar in public and private schools (77.7% vs 77.0%, p=0.71).

In addition, 631 were excluded because of no information or inconsistent information on key variables for this work and 93 were not considered for this analysis because their total energy intake was more than 3 interquartile deviations or their intake of fruit or vegetables was more than 1.5 interquartile deviations. The final sample includes 1436 students (765 girls [53.3%] and 671 boys [46.7%]).

The baseline evaluation comprised two self-administered questionnaires and a physical examination. One questionnaire was completed at home and another was completed at school immediately before physical examination during the field team visit.

The home questionnaire comprised information on the characteristics of the adolescents and the family, namely, demographic, social, behavioural, as well as information on perinatal circumstances and the overall medical history and medical care use.

Parents' educational level was recorded as an index of social and economic class. Each adolescent was finally classified according the highest completed degree regardless of maternal or paternal. The same procedure was followed considering parents profession, which were obtained for both parents using open questions.

We recorded for physical activity evaluation the extra curricular activities. Leisure time activity was obtained after completion of a set of questions focusing on the self-perceived usual energy expenditure. To quantify usual practices of sports, adolescents where asked to indicate the name of organized and unorganized sports, and the total time spent per week on each sport. Time spent watching TV was evaluated as mean hours per day, separately for week and weekend days. The total hours were computed and participants were classify in three categories: watching 1 hour or less per day, between 1 and 2 hours and those that watching more than 2 hours per day.

Dietary intake was evaluated using a semi-quantitative food frequency questionnaire (FFQ), previously validated in the Portuguese adult population (136-137) and added food items more eat by adolescents. The FFQ comprises 92 food or food group items and an additional section to add food or food group items missing at the list. Respondents were asked to report how often they usually consumed each particular food over the prior 12-month period as the

number of times per day, week, or month. For each food item, participants were asked to indicate their usual consumption in any of nine frequency categories, ranging from never or less than 1 per month to 6 or more per day. The food frequency questionnaire did not include specific questions on portion size, a standard portion size has been considered for nutrient calculation. The frequency reported was multiplied by the previously defined average portion size to estimate the intake in grams or millilitres. To estimate the nutrient intake we used the nutrient contents of the individual food items using an USA data base (Food Processor Puls® version: 7.02). Soft drinks included soda, Ice-Tea®, fruit juices and nectars packaged.

During the visit of the research team to the schools, adolescents answered an additional self-administered questionnaire comprising further information on health-related behaviours. Physical activities were also reported according to a set of close questions about the frequency and time spent in sports activities out of school.

Physical examination was performed at school, between 8 a.m. and 10 a.m. after 12-hours overnight fast, by a team of experienced nurses, nutritionists and doctors, following standardized procedures. The evaluation at school included measurements of anthropometry, blood pressure, lung function and bone mineral density.

Weight was measured using a digital scale - Tanita® (in kilograms, to the nearest tenth), and height was measured (in centimetres, to the nearest tenth) using a portable stadiometer. Body mass index was calculated and classified according to the age and sex specific body mass index reference percentiles, developed by the United States Centers for Disease Control and Prevention (138).

Table 1 presented the comparison between adolescents included and excluded.

Table 1. Comparison between adolescents included and excluded.

	Excluded	Included	p
	724 (33.5%)	1436 (66.5%)	
Sex			
Girls	351(48.5%)	765(53.3%)	0.040
Boys	373(51.5%)	671(46.7%)	
Type of school			
Public	611(84.4%)	1040(72.4%)	<0.001
Private	113(15.6%)	396(27.6%)	
Parents education (years)Ŧ	9.0(± 4.44)	11.0(± 4.54)	<0.001
Missing	*85*	*11*	
Body mass index (Kg/m^2)*			
<P_{85}	485(73.2%)	1010(73.4%)	0.852
≥ P_{85} e < P_{95}	107(16.1%)	229(16.6%)	
≥ P_{95}	71(10.7%)	137(10.0%)	
Missing	*61*	*60*	
Sports outside school			
Never	342(53.4%)	660(48.9%)	0.007
≤ 1 times/week	64(10.0%)	202(15.0%)	
2 times/week to every day	234(36.6%)	487(36.1%)	
Missing	*84*	*87*	
Sports to the point of being breathless			
Never	220(34.5%)	460(34.4%)	0.303
≤ 1 times/week	310(48.6%)	614(45.9%)	
2 times/week to every day	108(16.9%)	263(19.7%)	
Missing	*86*	*99*	

Ŧ Mean (± Standard Deviation)

* According to the age and sex specific body mass index references percentiles developed by the United States Centers for Disease Control and Prevention.

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5. CHAPTER I

EFFECT OF TELEVISION VIEWING ON FOOD AND NUTRIENTS INTAKE AMONG ADOLESCENTS

EFFECT OF TELEVISION VIEWING ON FOOD AND NUTRIENTS INTAKE AMONG ADOLESCENTS

ABSTRACT

Objective: To analyse food and nutrients intake according to time spent watching TV, in young adolescents.

Design: A cross-sectional evaluation carried out in 2003/2004 school year. Information was collected by self-administered questionnaires and a physical examination was performed. Dietary intake was evaluated using a semi quantitative food frequency questionnaire.

Setting: Public and private schools of Porto city, Portugal.

Subjects: 1436 adolescents of 13-year-old enrolled at schools.

Results: Spending more than 2 hours per day watching TV was significantly associated with higher intake of total fat and poly-unsaturated fat and was associated with lower intake of magnesium, in both genders. In addiction, in girls, spending more than 2 hours per day watching TV was associated with lower intake of complex carbohydrates, fiber, total vitamin A, folate, vitamin C, calcium, iron, phosphorus and potassium. In boys, higher intake of saturated fat and cholesterol was found among those with watching TV more time.

Conclusions: We found that television viewing is associated with higher consumption of higher-fat and sugar food and less fruit and vegetables. Consequently, adolescents that watched more television presented higher intake of total fat and poly-unsaturated fat and lower intake of minerals and vitamins. This dietary behaviour among adolescents may have long-term health implications.

INTRODUCTION

Overweight in children and adolescents are increasing on a global scale (1-2) as result of an energy imbalance in which energy intake is greater than energy expenditure. Among the large number of determinants of obesity, time spent watching TV has been recognized as a risk factor for obesity among children and adolescents (3). Furthermore, TV viewing during childhood and adolescence is associated with overweight in adulthood (4).

Some mechanisms have been proposed in attempt to explain how TV impacts on weight gain. One discuss mechanisms are the reducing energy expenditure, not only because it is a sedentary activity but also for the reduction of time spent in more active physical activities (5). Other mechanism is by the effect on dietary intake (5).

Previous studies demonstrating that TV viewing is associated with less desirable dietary behaviours, including increased energy intake (6-9), increased consumption of high-energy foods like snacks, fast-food and soft drinks (8, 10-15), and decreased consumption of fruit and vegetables (8, 11-13, 15-16). Nevertheless, this association was widely studied among children and older adolescents and data from young adolescents are less available.

During young adolescence adolescents' have progressively more control over what they eat, when and where making personal choices and preferences gain priority over eating habits acquired in the family (17-18). Also they became more expose to the influence of their peers, other community members, and advertisements (19). On the other hand, as the major interest in the development of those studies as been based on the relation between TV viewing and obesity, the majority was been focus on energy intake or macronutrients intake. To our knowledge only few studies have examined the association between television viewing and some vitamins and minerals. Thus, know the association between television viewing and nutrient intake among young adolescents still an important issue, particularly because in this period of life the rapid growth creates an increased demand for some nutrients and an inadequate intake during this period can have long-term health implications (20-21).

Among the behaviours that were associated with food intake, exposure to television is particularly important given the amount of adolescents exposed. Accordingly, the American Academy of Pediatrics recommends that television watching for children should be limited to no more than 2 hours of quality programming per day (22). However, recent results of the 2005-2006 Health Behaviour in School-aged Children (HBSC) project indicate that 70% of 13-year-old adolescents report watching TV more than 2h each day in WHO European regions (23). In Portugal, 82% of girls and 76% of boys reported watching more than 2 h per day (23).

The aim of this study was to analyse food and nutrients intake according to time spent watching TV, in young adolescents.

PARTICIPANTS AND METHODS

Participants were evaluated in 2003/2004 during the assembling of a cohort of urban adolescents born in 1990 and enrolled at Porto schools, known by the acronym EPITeen (Epidemiological Investigation of Teenagers' Health in Porto) (24). We identified 2787 eligible adolescents. Forty-four adolescents (1.6%) could not been reached (absent from classes during the study period), 583 (20.9%) were considered refusals since no signed informed consent form was returned, and 2160 (1561 public and 509 private school students) agreed to participate and provided information at least for part of the planned assessment. This resulted in a 77.5% overall participation proportion, similar in public (77.7%) and private schools (77.0%), p=0.709. In Portugal, education is compulsory by law for 13-year-old adolescents, making schools an ideal sampling frame.

The Ethical Committee of the University Hospital of São João, Porto, approved the study. Parents and adolescents received written and oral information explaining the purpose and the design of the study. Written informed consent was obtained both from parents and adolescents.

The evaluation comprised two self-administered questionnaires (one completed at home, another at school), and a physical examination performed at school.

The home questionnaire was completed by the adolescents with help from their parents, and inquired into demographic, social, behavioral and clinical characteristics of the adolescent and family. At school, during the research team's visit, adolescents responded to an additional questionnaire comprising further information on physical activity, smoking and alcoholic beverage intake.

Time spent watching TV was evaluated as mean hours per day, asked separately for week and weekend days. The total hours were computed and participants were classifying in three categories: watching 1 hour or less per day, between 1 and 2 hours and those that watching more than 2 hours per day.

As part of the home questionnaire, dietary intake was evaluated using a food frequency questionnaire (FFQ), previously validated in the Portuguese adult population (25-26) and added food items more eat by adolescents. The FFQ comprises 92 food or food group items and an additional section to add food eat at list one time per week and missing at the list. For each food item, participants were asked to indicate their usual consumption over the prior 12-month in any of nine frequency categories, ranging from never or less than 1 per month to 6 or more per day. The FFQ did not include specific questions on portion size, a standard portion size has been considered for nutrient calculation. The frequency reported was multiplied by a previously defined average portion size to estimate the intake in grams or millilitres. To estimate the nutrient intake we used the nutrient contents of the individual food items using an USA data base (Food Processor Plus® version: 7.02).

Anthropometric measures were obtained with the subject wearing light clothes and no shoes. Weight was measured using a digital scale - Tanita® (in kilograms, to the nearest tenth), and height was measured (in centimetres, to the nearest tenth) using a portable stadiometer. Body mass index was calculated and classified according to the age and sex specific body

mass index reference percentiles, developed by the United States Centers for Disease Control and Prevention (27).

Of the 2160 participants, 270 did not respond to the home questionnaire, 275 did not respond to the FFQ and 86 had no information on time spent watching TV or inconsistent information. Other 93 participants were not considered for this analysis because their total energy intake was more than 3 interquartile deviations or their intake of fruit or vegetables was more than 1.5 interquartile deviations. Thus our data comprise 1436 adolescents. Adolescents included in this analysis were compared with those excluded. Those excluded were significantly more male, with parents more educated and mostly from public schools. As type of school and parental education are indicators of social class, we can assume that excluded adolescents are essentially from low social classes, witch is also reflected in a lower proportion of adolescents playing sports outside of school. No significant differences were found to BMI and sports to the point of being breathless.

Data were analysed separately for boys and girls. Proportions were compared using the Chi-square test and median using Anova or Kruskal-Wallis test. Adjustments for parent's education and total energy intake were made using ordinal logistic regression analysis to estimated proportional odds ratio (POR) and 95% confidence interval (95%CI). For the ordinal logistic regression categories of cakes, cookies, soft drinks, chocolates, snacks of chocolate, sweets, fruit and vegetables were based on quartiles, and categories of pizza, hamburger and salty snacks were based on tertiles.

RESULTS

In these 13-year-old Portuguese adolescents, the median (25th-75th percentile) time spent watching television was 120.0 (77.1-180.0) minutes. In both genders, public school presented a significant higher proportion of adolescents that watched more than 2 hours of TV per day, also the mean parent's education of adolescents that watched TV more time was

lowest. No statistically significant differences were found according to body mass index. Girls that watched more than 2 hours of TV per day reported less practice of sports (Table 1).

Considering the likelihood ratio of change category we can state that in girls, spending more than 2 hours per day watching TV was associated with higher intake of cakes (POR=1.86; 95%CI 1,26-2.74), soft drinks (POR=2.01; 95%CI 1.37-2.94), chocolate (POR=1.84; 95%CI 1.26-2.69), snacks of chocolate (POR=2.07; 95%CI 1.42-3.03) and sweets (POR=1.70; 95%CI 1.16-2.49), and was associated with lower intake of vegetables (POR=0.92; 95%CI 0.42-0.90). In boys, adolescents who reported watching more than 2 hours of TV per day were more likely to consume sweets (POR=1.91; 95%CI 1.27-2.88), hamburger (POR=1.72; 95%CI 1.13-2.61), salty snacks (POR=1.73; 95%CI 1.07-2.80) and less fruit (POR=0.68; 95%CI 0.45-1.01), although only marginally significant (Table 2).

Intakes of total energy and nutrients according categories of time watching TV are shown in table 3 and 4. In both genders, adolescents that watched more than 2 hours of TV presented a significantly higher intake of total fat, saturated fat, poly-unsaturated fat and cholesterol and lower intake of fiber, vitamin C, magnesium and potassium. Additionally, girls presented significantly lower intakes of proteins, complex carbohydrates, total vitamin A, folate, calcium, iron and phosphorus.

Considering nutrient intake we can state that spending more than 2 hours per day watching TV was significantly associated with higher intake of total fat and poly-unsaturated fat and was associated with lower intake of magnesium, in both genders (Table 5, 6). In addiction, in girls, spending more than 2 hours per day watching TV was associated with lower intake of complex carbohydrates, fiber, total vitamin A, folate, vitamin C, calcium, iron, phosphorus and potassium (Table 5). In boys, higher intake of saturated fat and cholesterol was found among those with watching TV more time (Table 6).

DISCUSSION AND CONCLUSION

The results of this study show that adolescents who watching more than 2 hours per day were more likely to consume higher-fat and sugar food and less fruit and vegetables. These results of food intake also conditioned nutrients intakes. More time watching TV is significantly associated with higher intake of total fat and poly-unsaturated fat and was associated with lower intake of minerals and vitamins.

These results on food intake are consistent with previous studies that shows higher consumption of fast-food, soft drinks and snacks (8, 10-15) and lower consumption of fruit and vegetables (8, 11-13, 15-16) according to time spent watching TV. Also were in accordance with data from Utter et al (8) that found a significantly higher percent of fat energy among adolescents in the high television/video category than the average and lower users. Also Manios et al (9) found significantly higher consumption of total fat among children who watching TV more than 2 hours per day. However our results differ from those reported by Proctor et al. who found no clear pattern of differences in the intakes of fat, carbohydrates, proteins, vitamin A and magnesium, and higher calcium intake (7). Nevertheless we need to see carefully the results found by Proctor et al due the small sample size in their study.

Some previous studies reported that energy intake increased with increased TV viewing among children and adolescents and also BMI (6-9). Although we found no significant differences in energy intake or distribution by categories of BMI according to time spent viewing TV, our work is important because it shows that the effect of TV on food intake is beyond the problem of obesity.

During the period of adolescence there is an increased demand of nutrients and an inadequate intake of nutrients during adolescence can also have long-term health implications (20-21). The greater consumption of fast food, soft drinks, cakes and chocolates justify the high fat intake and low intake of vegetables and fruit justifies the results for the minerals and vitamins. Despite the inconsistency of studies, the American Heart Association

recommend limiting consumption of fats, especially saturated, and adequate intake of fruit and vegetables, combined with an active lifestyle in order to reduce the risk of cardiovascular disease (28). Thus based in our data is expectable that larger times viewing TV may contribute to an environmental favourable to the development of atherosclerosis and increased the risk to cardiovascular diseases during life time.

The effect of calcium intake during adolescence is one of the most intensely studied areas of pediatric bone health because adolescence is the most critical period for bone accrual (29). Since in general the calcium intake in children and adolescents is lower than recommended, the reduction in calcium intake observed in the group that sees more TV, added with the lower physical activity in this group, may contribute to poor bone health in the long term (30).

One of the main difficulties in assessing the nutrient intake is the lack of tools to enable precise measurement of food consumption. In this study, dietary intake was evaluated using a FFQ, previously validated in the Portuguese adult population (25-26) and added food items more eat by adolescents. Moreover, adolescents were also encouraged to list in an open-section, foods eaten at least once per week, which were not in the FFQ. In epidemiological studies of large scale, this type of questionnaire has been the most widely used method for assessment of food intake, since it is considered one of the most simple, quick to administer and not very expensive (31). Another limitation is the absence of a database with Portuguese food composition, has therefore been necessary to resort to a database that includes the composition of foreign foods. Despite the adjustments made to the Portuguese population, may have been thus introduced some errors in some specific nutrients, for which there is no nutritional information updated.

A strength of our study is the sample size and it is important to enhance that the school education is compulsory in Portugal until 15 years of age so it is expected that all the adolescents born in 1990 were attending school. Although these adolescents are from a specific region of the country, are not expected to be different from other Portuguese adolescents, especially those who also reside in urban areas.

This study, although is in accordance with previous studies adds information on the effect on nutrients intakes. Thus our findings suggest that the effect of television on dietary intake is not limited to obesity and higher consumption of unhealthy foods but also has important nutritional implications with regard to the reduction of intake of healthy nutrients and consequently may have long-term health implications.

Table 1. Description of the characteristics according categories of time watching TV, by sex.

	≤ 60 minutes	61-120 minutes	>120 minutes	p
Girls	125(16.3%)	242(31.6%)	398(52.0%)	
Type of school				
Public	67(53.6%)	160(66.1%)	314(78.9%)	<0.001
Private	58(46.5%)	82(33.9%)	84(21.1%)	
Parents education (years)Ŧ	12.6(± 4.34)	11.2(± 4.55)	9.8(± 4.36)	<0.001
Body mass index (Kg/m^2)*				
<P_{85}	94(79.7%)	192(80.3%)	270(71.2%)	0.059
≥ P_{85} e < P_{95}	16(13.6%)	25(10.5%)	67(17.7%)	
≥ P_{95}	8(6.8%)	22(9.2%)	42(11.1%)	
Sports outside school				
Never	53(46.9%)	118(50.0%)	253(59.7%)	<0.001
≤ 1 times/week	19(16.8%)	38(16.1%)	51(13.5%)	
2 times/week to every day	41(36.3%)	80(33.9%)	74(19.6%)	
Sports to the point of being breathless				
Never	41(36.3%)	93(39.9%)	188(50.5%)	0.005
≤ 1 times/week	50(44.2%)	112(48.1%)	148(39.8%)	
2 times/week to every day	22(19.5%)	28(12.0%)	36(9.7%)	
Boys	121(18.0%)	205(30.6%)	345(51.4%)	
Type of school				
Public	72(59.5%)	142(69.3%)	285(82.6%)	<0.001
Private	49(40.5%)	63(30.7%)	60(17.4%)	
Parents education (years)Ŧ	14.0(± 4.12)	11.7(± 4.26)	10.1(± 4.37)	<0.001
Body mass index (Kg/m^2)*				
<P_{85}	75(66.4%)	141(71.6%)	238(72.1%)	0.731
≥ P_{85} e < P_{95}	23(20.4%)	36(18.3%)	62(18.8%)	
≥ P_{95}	15(13.3%)	20(10.2%)	30(9.1%)	
Sports outside school				
Never	40(35.7%)	57(30.0%)	139(43.4%)	0.037
≤ 1 times/week	18(16.1%)	29(15.3%)	47(14.7%)	
2 times/week to every day	54(48.2%)	104(54.7%)	134(41.9%)	
Sports to the point of being breathless				
Never	18(16.1%)	46(24.0%)	74(23.5%)	0.211
≤ 1 times/week	54(48.2%)	99(51.6%)	151(47.9%)	
2 times/week to every day	40(35.7%)	47(24.5%)	90(28.6%)	

Ŧ Mean (± Standard Deviation)

* According to the age and sex specific body mass index references percentiles developed by the United States Centers for Disease Control and Prevention.

Table 2. Associations between time spent watching TV and quartiles and tertiles of food intake, by sex*.

	≤ 60 minutes	**61-120 minutes**	**>120 minutes**
Girls	POR(95%)	POR(95%)	POR(95%)
Cakes	**1**	**1.26 (0.84-1.90)**	**1.86 (1.26-2.74)**
Cookies	1	O.96 (0.64-1.44)	1.09 (0.74-1.59)
Soft drinks	**1**	**1.98 (1.32-2.95)**	**2.01(1.37-2.94)**
Chocolates	**1**	**1.68 (1.13-2.49)**	**1.84 (1.26-2.69)**
Snacks chocolate	**1**	**1.40 (0.94-2.08)**	**2.07 (1.42-3.03)**
Sweets	**1**	**1.46 (0.98-2.18)**	**1.70 (1.16-2.49)**
Hamburger	1	0.95 (0.63-1.43)	1.38 (0.93-2.04)
Pizza	1	0.98 (0.65-1.50)	1.09 (0.74-1.63)
Salty snacks	1	1.21 (0.76-1.92)	1.17 (0.75-1.82)
Fruit	1	0.72 (0.48-1.08)	0.79 (0.54-1.17)
Vegetables	**1**	**0.64 (0.43-0.95)**	**0.92 (0.42-0.90)**
Boys	POR(95%)	POR(95%)	POR(95%)
Cakes	1	0.78 (0.51-1.19)	1.20 (0.80-1.79)
Cookies	1	0.86 (0.57-1.31)	0.96 (0.64-1.43)
Soft drinks	1	0.98 (0.65-1.48)	1.24 (0.83-1.85)
Chocolates	1	0.97 (0.64-1.48)	0.88 (0.59-1.32)
Snacks chocolate	1	1.01 (0.67-1.53)	0.91 (0.61-1.36)
Sweets	**1**	**1.69 (1.11-2.60)**	**1.91 (1.27-2.88)**
Hamburger	**1**	**1.40 (0.90-2.15)**	**1.72 (1.13-2.61)**
Pizza	1	1.40 (0.89-2.19)	1.03 (0.67-1.58)
Salty snacks	**1**	**1.55 (0.94-2.56)**	**1.73 (1.07-2.80)**
Fruit	**1**	**0.86 (0.57-1.31)**	**0.68 (0.45-1.01)**
Vegetables	1	1.36 (0.90-2.06)	1.10 (0.74-1.63)

*proportional odds ratio (POR) to the increase intake of each food item, adjusted for parent's education and total energy intake.

Table 3. Intakes of total energy and nutrients according categories of time watching TV, in girls.

Girls	≤ 60 minutes	61-120 minutes	>120 minutes	p
Energy	2263 (1865-2805)	2359 (1936-2839)	2361 (1891-2897)	0.470
Proteins (g/100Kcal)	18.0 (16.1-19.3)	17.1 (15.5-18.8)	16.8 (15.4-18.9)	0.004
Total fat (g/100Kcal)	31.2 (28.8-35.7)	31.6 (28.4-33.9)	32.5 (30.0-35.4)	<0.001
Saturated fat (g/100Kcal)	10.7 (9.4-11.9)	10.7 (9.6-11.9)	11.0 (10.0-12.1)	0.006
Mono-unsaturated fat (g/100Kcal)	13.2 (11.5-14.6)	12.7 (11.1-14.0)	13.1 (11.7-14.6)	0.008
Poly-unsaturated fat (g/100Kcal)	5.0 (4.3-5.7)	4.9 (4.4-5.6)	5.3 (4.6-6.1)	<0.001*
Cholesterol (mg/100Kcal)	126.8 (108.7-150.7)	127.4 (106.4-148.7)	134.7 (113.8-155.9)	0.044*
Carbohydrate (g/100Kcal)	52.1 (49.9-56.3)	52.8 (50.2-57.1)	52.0 (48.3-55.4)	0.004
Complex Carbohydrate (g/100Kcal)	16.5 (14.1-18.9)	16.2 (12.5-18.7)	15.4 (13.4-17.5)	<0.001
Fiber (g/100Kcal)	1.11 (0.94-1.27)	1.02 (0.87-1.17)	0.96 (0.79-1.15)	<0.001
Total vitamin A (RE/100Kcal)	97.4 (63.7-134.2)	86.3 (63.0-122.2)	79.5 (56.8-112.2)	0.008*
Vitamin D (mcg/100Kcal)	0.16 (0.13-0.22)	0.17 (0.13-0.23)	0.16 (0.12-0.16)	0.269*
Vitamin E (mg/100Kcal)	0.37 (0.34-0.46)	0.36 (0.30-0.41)	0.36 (0.30-0.42)	0.015*
Folate (mcg/100Kcal)	17.6 (14.6-21.2)	16.4 (13.5-19.8)	15.4 (12.9-19.0)	<0.001*
Vitamin C (mg/100Kcal)	7.3 (5.5-9.4)	6.5 (4.7-8.2)	5.9 (4.4-8.1)	0.001*
Calcium (mg/100Kcal)	49.2 (42.0-59.9)	46.8 (37.1-55.8)	42.9 (34.9-52.6)	0.002
Iron (mg/100Kcal)	0.77 (0.69-0.87)	0.75 (0.66-0.88)	0.73 (0.61-0.82)	<0.001
Magnesium (mg/100Kcal)	16.0 (14.5-16.8)	15.1 (13.8-16.2)	14.5 (13.1-15.8)	<0.001
Phosphorus (mg/100Kcal)	71.1 (64.7-77.1)	67.5 (61.2-73.6)	65.2 (58.5-71.9)	0.001
Potassium (mg/100Kcal)	173.7 (153.7-187.1)	163.0 (143.4-178.9)	157.3 (139.5-177.0)	<0.001

Median (25th-75th percentile)

* Comparison based on Kruskal-Wallis test.

Table 4. Intakes of total energy and nutrients according categories of time watching TV, in boys.

Boys	≤ 60 minutes	61-120 minutes	>120 minutes	p
Energy	2450 (1999-3028)	2403 (2034-2857)	2418 (1959-3037)	0.668
Proteins (g/100Kcal)	17.3 (16.1-19.1)	17.4 (15.6-19.5)	17.2 (15.5-18.9)	0.137
Total fat (g/100Kcal)	31.2 (28.5-33.5)	32.3 (29.5-35.5)	32.4 (30.0-34.7)	0.006
Saturated fat (g/100Kcal)	10.1 (9.2-11.7)	10.8 (9.9-12.2)	11.0 (10.0-12.1)	0.001
Mono-unsaturated fat (g/100Kcal)	12.8 (11.7-14.3)	13.2 (11.6-14.7)	12.9 (11.6-14.2)	0.203
Poly-unsaturated fat (g/100Kcal)	4.6 (4.2-5.3)	5.0 (4.5-5.7)	5.3 (4.6-6.1)	<0.001*
Cholesterol (mg/100Kcal)	124.1 (108.2-144.0)	131.1 (113.5-153.3)	134.5 (111.8-157.7)	0.024*
Carbohydrate (g/100Kcal)	53.2 (49.1-56.1)	51.7 (47.7-55.6)	52.0 (48.4-55.2)	0.064
Complex Carbohydrate (g/100Kcal)	16.3 (14.6-18.5)	16.1 (13.9-18.5)	16.2 (14.1-17.9)	0.125
Fiber (g/100Kcal)	1.03 (0.85-1.20)	0.97 (0.81-1.16)	0.93 (0.80-1.08)	<0.001
Total vitamin A (RE/100Kcal)	84.0 (58.9-118.3)	84.9 (61.5-118.3)	81.2 (60.3-111.9)	0.647*
Vitamin D (mcg/100Kcal)	0.15 (0.12-0.23)	0.17 (0.13-0.22)	0.18 (0.13-0.23)	0.266*
Vitamin E (mg/100Kcal)	0.36 (0.31-0.41)	0.36 (0.31-0.41)	0.34 (0.29-0.41)	0.058*
Folate (mcg/100Kcal)	16.0 (13.4-21.1)	16.6 (13.2-20.2)	15.9 (13.0-19.3)	0.317*
Vitamin C (mg/100Kcal)	6.5 (4.6-8.6)	5.8 (4.4-7.8)	5.5 (4.0-7.2)	0.006*
Calcium (mg/100Kcal)	46.4 (37.9-55.4)	44.6 (38.3-54.2)	44.4 (36.0-54.4)	0.323
Iron (mg/100Kcal)	0.75 (0.66-0.90)	0.75 (0.65-0.85)	0.74 (0.63-0.84)	0.105
Magnesium (mg/100Kcal)	15.2 (14.0-16.8)	14.8 (13.4-16.0)	14.7 (13.1-15.5)	<0.001
Phosphorus (mg/100Kcal)	68.4 (62.7-75.0)	67.9 (61.3-73.9)	66.3 (60.3-73.8)	0.180
Potassium (mg/100Kcal)	163.6 (147.8-185.6)	158.4 (141.6-178.4)	154.4 (138.3-171.2)	<0.001

Median (25th-75th percentile)

* Comparison based on Kruskal-Wallis test.

Table 5. Associations between time spent watching TV and quartiles of nutrients and vitamins intake, in girls.

	≤ 60 minutes	61-120 minutes	>120 minutes
Girls	POR(95%)	POR(95%)	POR(95%)
Proteins	1	0.70 (0.44-1.11)	0.75 (0.49-1.16)
Total fat	1	0.92 (0.56-1.49)	**1.60 (1.01-2.54)**
Saturated fat	1	0.91 (0.57-1.47)	1.49 (0.95-2.33)
Mono-unsaturated fat	1	0.78 (0.49-1.24)	1.43 (0.92-2.21)
Poly-unsaturated fat	1	0.97 (0.62-1.51)	**1.75 (1.15-2.67)**
Cholesterol	1	0.98 (0.64-1.50)	1.35 (0.91-2.02)
Carbohydrate	1	1.40 (0.83-2.37)	0.83 (0.51-1.36)
Complex Carbohydrate	1	0.81 (0.52-1.26)	**0.63 (0.41-0.96)**
Fiber	1	**0.62 (0.40-0.96)**	**0.41 (0.27-0.62)**
Total vitamin A	1	0.79 (0.53-1.19)	**0.65 (0.46-0.96)**
Vitamin D	1	1,00 (0.67-1.49)	0.89 (0.61-1.30)
Vitamin E	1	0.73 (0.47-1.13)	0.83 (0.55-1.26)
Folate	1	**0.60 (0.39-0.92)**	**0.49 (0.32-0.73)**
Vitamin C	1	**0.64 (0.42-0.96)**	**0.59 (0.40-0.87)**
Calcium	1	0.66 (0.43-1.01)	**0.45 (0.30-0.68)**
Iron	1	0.69 (0.44-1.08)	**0.53 (0.35-0.82)**
Magnesium	1	0.71 (0.44-1.16)	**0.50 (0.31-0.79)**
Phosphorus	1	0.64 (0.40-1.02)	**0.55 (0.35-0.85)**
Potassium	1	**0.56 (0.35-0.89)**	**0.44 (0.28-0.68)**

*proportional odds ratio (POR) to the increase intake of each food item, adjusted for parent's education and total energy intake.

Table 6. Associations between time spent watching TV and quartiles of nutrients and vitamins intake, in boys.

	≤ 60 minutes	61-120 minutes	>120 minutes
Boys	POR(95%)	POR(95%)	POR(95%)
Proteins	1	1.10 (0.68-1.79)	0.80 (0.50-1.28)
Total fat	1	1.53 (0.91-2.55)	**1.71 (1.03-2.83)**
Saturated fat	1	1.92 (1.18-3.14)	**2.08 (1.29-3.36)**
Mono-unsaturated fat	1	1.45 (0.89-2.36)	1.19 (0.74-1.91)
Poly-unsaturated fat	1	1.53 (0.95-2.46)	**2.05 (1.29-3.25)**
Cholesterol	1	1.40 (0.89-2.18)	**1.73 (1.13-2.67)**
Carbohydrate	1	**0.57 (0.33-0.98)**	0.59 (0.35-1.02)
Complex Carbohydrate	1	0.87 (0.55-1.39)	0.71 (0.45-1.11)
Fiber	1	0.88 (0.56-1.38)	0.67 (0.43-1.05)
Total vitamin A	1	1.17 (0.77-1.78)	1.00 (0.67-1.49)
Vitamin D	1	1.15 (0.75-1.76)	1.40 (0.93-2.11)
Vitamin E	1	1.32 (0.84-2.08)	0.93 (0.60-1.43)
Folate	1	1.13 (0.73-1.75)	0.97 (0.64-1.48)
Vitamin C	1	0.86 (0.56-1.32)	0.66 (0.44-1.00)
Calcium	1	1.11 (0.71-1.72)	1.08 (0.71-1.64)
Iron	1	1.24 (0.78-1.97)	0.90 (0.57-1.41)
Magnesium	1	0.90 (0.54-1.51)	**0.60 (0.36-0.98)**
Phosphorus	1	0.89 (0.55-1.46)	0.80 (0.50-1.29)
Potassium	1	0.88 (0.55-1.42)	0.74 (0.47-1.18)

*proportional odds ratio (POR) to the increase intake of each food item, adjusted for parent's education and total energy intake.

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