



Eating Patterns in Children, an Issue for Future Health Policy

Bianca Elena Popovici*, Maria Mitrica, Moga Marius

Department of Medical and Surgical Science, Faculty of Medicine, "Transilvania" University, Brasov, Romania

Email address:

biancadr@yahoo.com (B. E. Popovici)

*Corresponding author

To cite this article:

Bianca Elena Popovici, Maria Mitrica, Moga Marius. Eating Patterns in Children, an Issue for Future Health Policy. *Science Journal of Chemistry*. Vol. 10, No. 1, 2022, pp. 13-20. doi: 10.11648/j.sjc.20221001.12

Received: February 3, 2021; **Accepted:** February 23, 2021; **Published:** January 28, 2022

Abstract: Background: Obesity and overweight have increased prevalence in children during the last decades all over the world. Objectives: The aim of this study was to determine the prevalence of overweight/obesity through the 12-18 year old schoolchildren in Brasov district and to describe eating patterns and the possible relationship between overweight/obesity and eating pattern. Material and Method: There were recruited 250 children for a cross-sectional study in Brasov district, Romania. Alimentary habit, snacking, meal frequencies were declared by the subjects using a retrospective questionnaire. Parents were asked to give information about family history regarding the presence of cardio-vascular risk factors. There were measured weight and height for all children and it was calculated body mass index calculated using international standard cutoff points (International Obesity Task Force values). It was also evaluated the level of physical activity for each children. Results: Positive family history for cardio-vascular risk factor, eating pattern and physical activity were associated with overweight. Healthy eating pattern including fresh fruits and vegetables loses ground in favour of fast-food as the age increases. Conclusions: The main finding was that, eating pattern in schoolchildren should worry both parents and school authorities. The family influence on children's eating pattern decreases as the age grows, the busy school program determines lack of physical activities and failure of and the healthy alimentation. The prevalence of overweight was high and connected with dietary behaviour, independent associations were evident between eating patterns and overweight, indicating the need of the need for a common intervention on nutrition both from the family and from the educators.

Keywords: Children, Nutritional Disorder, Obesity, Physical Activity

1. Introduction

In the 21st century obesity is considered as an "epidemic" disease of modern civilization. International statistics estimate that over the next 10 years, obesity will make more victims than smoking. On the other hand it had been estimated that 80% of heart diseases, strokes and diabetes type II and 40% of cancers could be avoided if risk factors like obesity should be eliminated [1].

It had been demonstrated, according with the trend of increasing incidence of obesity in European Union countries, that deteriorating of diet regarding its quality and a decrease in practicing physical activity in childhood could be the basis of the disease. The direct consequence is that childhood obesity is increasing in both the United States America, and in European countries [1]. In Romania there are not many

data regarding the incidence of the obesity in childhood but a briefly analyze of the social, economic and cultural environment allowed the presumption that are proper condition for promoting obesity. Spending increasingly more time indoors, watching television or computer programs, lower interest in sport as a mean of recreation, and an eating pattern strongly influenced of advertisement but out of parental and educators control, are sufficient mechanisms for overweight and obesity at early ages. Approximately 80% of overweight adolescents will remain so during adult life or even become obese adults which will have serious consequences for future adult health, increased risk of cardiovascular degenerative diseases, cancer, hypertension, type II diabetes, locomotion disorders and depression.

The aim of the study is to determine the prevalence of obesity in adolescents in district Brasov and to analyze

alimentary pattern and to establish a possible cause-effect relationship between these.

2. Material and Methods

We conducted a prospective study between March 2018 and March 2019, in a high school in Brasov city. The study included 250 students, boys and girls, aged between 12 and 18 years old. Before including each subject in the study-group all parents were asked to give the written consent for participating at study.

The study design comprised two stages.

First stage, all children underwent a complete clinical examination at the medical office, in the presence of medical nurse and medical school doctor. The examination was performed with subject wearing shirt and short, in an ambient with thermal comfort.

There were performed for every subject measurement of:

1. weight (W), using electronic scale (EKS) with a deviation of 0,1 kg.
2. height (H), using pedometer Electrometal with a deviation of 0,1 cm.

It had been calculated body mass index (BMI) according with formula:

$$\text{BMI} = \text{Weight} \times \text{Height}^{-2} \text{ (kg} \times \text{m}^{-2}\text{)}$$

The BMI data were evaluated according with the recommendation of "Centers for Disease Control and Prevention" [2-4].

Blood pressure (BP) values included in the study were considered the arithmetic average of three measurements made at 1 minute interval with subject in clinostatism, at right arm using an sphingomanometer Fazzini calibrated. The values obtained were analyzed and interpreted according with "The Fourth Report on the Diagnosis, Evaluation and Treatment of High Blood Pressure in Children and Adolescents. National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents" [5, 6].

The second stage of the study consisted of a questionnaire distributed to all children.

Subjects were encouraged to answer to the questions themselves, with sincerity, under protection of anonymity especially regarding alcohol consumption and smoking. Parental intervention was asked only about family history of chronic disease. The confidentiality of responses was an important issue so that subjects could answer honestly without fear of making public the answers and of ant repercussions from parents or educators.

The questionnaire had included the following:

1. Identification data: name, age, gender;
2. A family history: the presence of chronic diseases in first and second degree relatives. There were of interesting for the study diseases like: essential hypertension, cardiovascular disease as myocardial infarction, stroke, obesity, dyslipidemia, type II diabetes (we admitted the participation of the parents at this point);
3. Meals / day: regular / irregular (motivation); we

consider regular meal timetable: breakfast, lunch and dinner and two snacks at 10,00 am and 4,00 pm.

4. Data related to the regularity of consumption of fruits and vegetables; it had been requested an accurate frequency appreciated as it follows: frequently – at least once per week, occasionally – at least once per month, never;
 5. Data related to the consumption of "fast food": frequently, occasionally, never;
 6. Data related to the consumption of carbonated sweetened beverages: frequently, occasionally, never;
 7. Data related to participation in physical education classes in school: yes / no (free medical / other reasons);
 8. Data related to the habit of sport practicing as recreation: yes /no;
 9. Data regarding the evaluation of the children's knowledge about obesity: evaluated with answer yes (children have knowledge) / no (children have not knowledge);
 10. Data regarding the necessity of a medical educational program in schools about obesity: evaluated with answer yes (it is necessary) / no (it is not necessary).
- Data were statistically analyzed.

Table 1. Demographic and clinical characteristics of study group.

Parameters	Values
Mean age	15,12
Gender	
Male (%)	56
Female (%)	44
BMI (kg.m ⁻²)	
Male	21,57
Female	21,45
Normal weight (%)	90,4
Overweight (%)	9,6
Blood pressure	
SBP (mean value, mmHg)	102,16
DBP (mean value, mmHg)	66,33
Family history	
Positive (%)	47,2
Negative (%)	52,8

BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure; *Family history = the presence of essential hypertension, obesity, diabetes mellitus type 2, dyslipidemia, chronic cardiovascular pathology.

3. Results and Discussions

Clinical examination, measurement of weight and height and BMI calculation, and blood pressure measurement were performed for all 250 participating children (100%) – 56% boys (no = 140) and 44% girls (no = 110). The demographic and clinical characteristics of the study group are presented in Table 1. Mean age was 15, 12 years. The distribution between normal weight and overweight was 226/250 (90,4%) and 24/250 (9,6%). The prevalence of overweight was 5,8% for girls and 3,8% for boys. There were no children with obesity. Blood pressure, systolic as well as diastolic values were normal for age, gender and height according with the

criteria included in "The Fourth Report on the Diagnosis, Evaluation and Treatment of High Blood Pressure in Children and Adolescents. National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents" [5, 6]. There were not children with criteria of hypertension or high – normal blood pressure.

The distribution of the number of subjects on age – groups is shown in Figure 1. The groups aged 13-14 years old and 14-15 years old had 25 subjects and the others groups had each one 50 subjects.

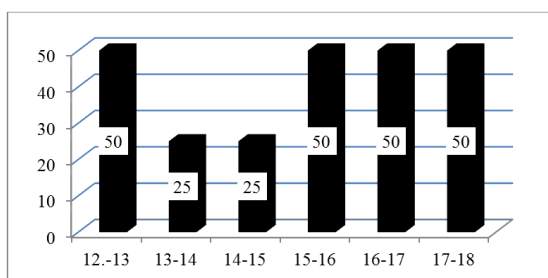


Figure 1. The distribution of the cases on age-groups.

The distribution on gender of the subjects was balanced and it is shown in Figure 2.

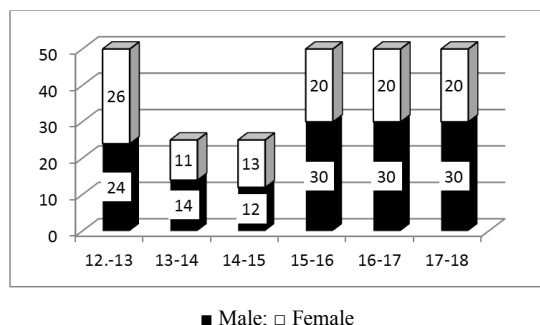


Figure 2. The distribution of the cases on gender and age-groups.

BMI was calculated for both gender, boys (BMI mean value = $21,57 \text{ kg} \cdot \text{m}^{-2}$) and girls (BMI mean value = $21,45 \text{ kg} \cdot \text{m}^{-2}$). BMI trend was to grow up with the age for boys as well for girls which could be considered a physiologic one but it has to be pointed out that the analyze of the BMI in subjects over the 17 years old, both boys and girls, met the criteria for overweight with values over the 95th for age and gender. There were 60 cases of overweight (24%). The majority of children (190 cases, 76%) had normal BMI for age and gender and this finding was quite surprising according with the food preferences that we found through questionnaires. There were no significant differences in terms of mean of BMI between boys and girls.

(BMI = $21,57 \text{ kg} \cdot \text{m}^{-2}$ for boys and BMI = $21,45 \text{ kg} \cdot \text{m}^{-2}$ for girls). For boys, the critical age was between 15 and 18 years of age with a slightly decrease for the 16 to 17 age-group and for girls, the critical domain was between 16 and 18 year of age. This could be due to many reasons, some of them physiologic, as sexual maturation, gain of muscular mass but also to some particular characteristics of this age connected

with social, emotional and psychologic changes. During adolescence period the children become more independent regarding a lot of aspects including dietary. The results are shown in Figures 3 and 4.

Blood pressure values were normal in all age-groups both in boys and girls. The mean value of systolic blood pressure was 102,16 mmHg and for the diastolic blood pressure was 66,33 mmHg.

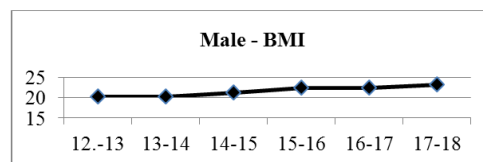


Figure 3. The distribution of BMI in males.

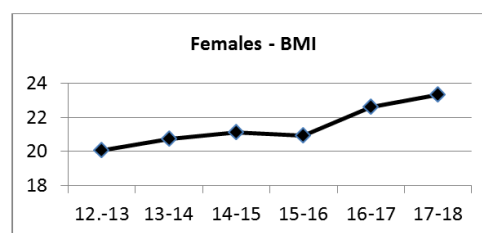


Figure 4. The distribution of BMI in females.

Family history was obtained for each subject through the questionnaires. Children were allowed to ask their parents regarding the data about medical family history. There were considered positive the presence of one or more of: essential hypertension, obesity, dyslipidemia, diabetes mellitus type 2, chronic cardiovascular diseases. Positive family history was in 118 subjects (47,2%) and negative in 132 (52,8%) (Figure 5). All the subjects included in "overweight" group (60 children) had positive family history, and also 58 children from "normal weight" group. Children with positive family history for cardio-vascular risk factors should be the target of "preventive medicine". They and their families should be advised about the necessity of dietary changes, life style changes including practicing regular sport or physical activities, avoiding or diminishing the consume of fast-food and beverages. They represent the future adults at risk for cardiovascular diseases. Studies had demonstrated that these children had already an "obesity-like" pattern of gaining weight in next years and during adulthood, and it is very likely they already have stiffness of carotid artery and early atherosclerotic structural changes of the vessels, subclinical modifications [7-9].

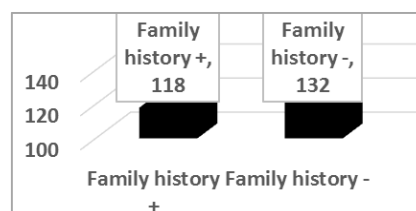


Figure 5. Family history.

The data obtained through questionnaires were processed. Because of the difference of number of cases in group 2 (age-group 13-14 years) and group 3 (age-group 14-15 years) each of them having 25 subjects comparative with the others groups of age with 50 subjects, the results were expressed in percentages to maintain the real proportion.

The first extensive study conducted in children was "Bogalusa Heart Study" who pointed out at that time that alimentation in children starting from two years old should worry both parents and physicians [10]. The diet, described as "typical American" for '80-'90 years, had a very high level of fat and sodium and a low contain in fiber. The impact was even higher when the information was correlated with pathological studies in children who died in car accident and at whom were present in the aorta atherosclerotic plaques beginning with 3 years of age, and in the coronary arteries over 10 years of age [11]. Moreover, these findings were not associated only with dietary but also with obesity, blood high level of low density lipoprotein -cholesterol (LDL - Cholesterol) and high blood pressure. It is already well known that metabolic syndrome and cardiovascular risk later in life is strongly connected with health status in childhood, from early ages (overweight or obesity, hypertension, glucose tolerance impairment, level of serum uric acid, dyslipidemia) [12]. The more risk factors involved, the greater atherosclerotic plaques extension [13].

After processing the data obtained from questionnaires the results were as it follows.

The consume of fresh fruits and vegetables was present in all children included in study. Until 15 years old age the daily consume was constantly present and this fact was probably due to the pressure exerted and the "positive" influence and control of the parents on the daily dietary of the children. After this age a slightly decrease of this habit had occurred followed by a slightly increase in adolescents. The presence of the fruits in children dietary became "weekly" instead of "daily" (Figure 6 and Figure 7). The finding should worry because the beneficial of fresh fruits and vegetables consumption was demonstrated, and highly recommended due to low caloric content, supply for micronutrients and fiber [14]. Fruits and vegetables are essential for prevention of the obesity. [15]. Losing of the good habit of fruits and vegetables consumption with age it should be an alarm signal because once the child is growing, re-education of good dietary habits become more difficult. Some studies had shown that despite the increase of fruits and vegetables consumption this still remain on a lower amount that is recommended, over 360 g/day according with American Heart Association [16] or over 400 g/day according with WGO guidelines [17].

The habit of eating cereals was present at all age-groups. As it was expected, the frequency of eating cereals decrease with increasing in age as it is shown in Figure 8. Until 14 years of age the majority of subjects used to eat it (43/50 in age-group 12-13 year and 19/25 in age-group 13-14 year). Starting with age 15 year the consume decreased dramatically (12/50 at age-group 15-16 year, 10/50 at age-

group 16-17 year and 7/50 at age-group 17-18 year). A weak point of this study was that there was not specified what kind of cereals were consumed. It is well known that children prefer sweetened, chocolate added cereals instead of whole grains which are less tasty. Common cereals in supermarket dedicated to children are with addition of sugar, chocolate, taste enhancers, and for this reason they are not healthy anymore. A study conducted in several countries across the world had shown that the product so called "ready-to-eat cereals" had an unhealthy nutrient profile with high intake of sugar, varying from a country to another (the highest level was found in United States), saturated fat and sodium level was also high (in United States and Canada comparing with Australia and United Kingdom) [18].

Over 15 year of age food preferences changed dramatically with evident decreasing in fresh vegetables and fruits and cereals consume.

The habit of fast-food consumption was present in all age-groups (Figure 9). Between 12 and 15 years the daily and weekly consume was almost in the same average, 25/50 (age-group 12-13 year) and 12/25 and 13/25 (age-group 13-14 year) and 12/25 and 13/25 (age-group 14-15 year). As the age increased the daily consumption of fast-food increased and the occasionally consumption decreased showing the typical alimentary preference in adolescence. This issue is of the most importance because intake of high energy food then requirements associated with encourage sedentary behavior and decrease of physical activity is strongly connected with obesity [19]. A study of Bowman *et al* [20] had shown that regular consume of fast-food is less healthful because of the high level of energy, the high energy density per gram, higher fat intake with low fruits and vegetables intake. There are data suggesting that consumption of fast food in children has increased by 300% in two decades [21]. Although there were some efforts in improving the nutritional quality of the fast-food meal, the results are quite modest at this time according with a study performed between 2003 and 2016 in United States [22]. It is also well known that fast-food and restaurants are on the top food advertising but we don't know yet the magnitude of the impact of it on the children. Some recent studies suggested that neural systems implicated in reward could be the key for understanding why food advertising influence food intake causing overeating and influencing food preferences [23]. It is hard to believe that once the unhealthy alimentary habits were consolidated in adolescent age they could be easily changed in future and turned to a good lifestyle.

Soft drinks consumption habit, especially sweetened and carbonated, was present in all subjects. The lowest daily consumption was in first age-group (20/50 subjects). The highest daily consumption was between 14 and 16 years old, decreasing constantly after age 16 (Figure 10). Usually soft drinks are not considering by children and even parents by having a great impact of diet and energy intake. They are assimilated with water consumption which is so wrong. In last decades the quantity of soft drinks had raised dramatically and should be account as an important source of sugar [24]. One

prospective study had reported a positive association between consumption of sugar-sweetened drinks and obesity [25, 26]. It is also connected with dental caries, with insulin resistance and caffeine-related effects [26]. Some studies had demonstrated that sugar-sweetened beverages consumption habit is hard to change even there were programs dedicated to family meals intervention or in school-based programs [14, 27]. In contrast, there were a study, combined school/community-based water campaign intervention who succeeded in reducing of sweetened beverages in children [28].

High energy diet intake as a result of increased consumption of fast-food and soft drinks, erratic food supply correlated with sedentary behavior is the milestone of obesity in adulthood [29] and probably, also in children [19].

Meal timetable is shown in Figure 12. Subjects included in primary school program had regular meal timetable in a greater percentage than subjects attending high school program (90% in 12-13 years, 86% in 13-14 years, 80% in 14-15 years of age-groups vs 44% in 15-16 years, 38% in 16-17 years and 44% in 17-18 years of age-groups). Most of children declared as main reason for failure of a regular meal timetable hard school program, homework, and extracurricular duties and private lessons. The last three age-groups especially complained about it claiming a constantly, permanently increased pressure from school, professors and parents. The crowded educational program was also the main reason for preferring quick snacks and fast-food which allowed them to save time. The majority of subjects, 186/250 (74,4%) used to skip breakfast and this habit makes them at increased risk of weight gain [30, 31]. All of them complained that there was not enough time to eat on two dishes at lunch time. Dinner was late in the night when subjects reached home or they used to skip dinner and preferred to eat snacks during the afternoon. In adults, some experimental research had shown changes in the number of eating episodes per day had little effect on body weight [19]. Snacks with high energy intake delayed the request for the next meal with less than an hour and did not reduce the energy consumed at the subsequent meal [32-34]. Positive results of some programs dedicated to improving eating habits in children had demonstrated that compliance on regular time table can change not only the alimentary habits but also can improve the quality of the diet, with higher energy intake at breakfast compared with afternoon [12].

Regarding the habit of playing sports, all the subjects were attending the physical education program included in the school curriculum. Practicing sport outside the school, was present in 165/250 subjects (66%) and most of the children were in primary school. As the age of the subjects increased was observed a decreased in practicing sport outside school. Lack of time for relaxation because of homework was the main reason for practicing less sport and all the subjects admitted that they would like to spare more time with physical activities (Figure 11).

These results are suggestive for a sedentary "lifestyle" which is favorable to obesity in children. The results are similar with other previous studies which had demonstrated

a while ago a marked decrease in physical activity in the older and preadolescent child [35]. Some studies in United Kingdom had shown that children appear to become less active as they get older, and in adolescence physical activities decrease significant [36]. According with a study performed by Joo and others, a 15-week exercise training could help pursuing a healthier dietary and regulating the food intake [37].

So called "obesogenic" environment involved in unfavorable outcome of the overweight children. Although in the study group there were not obese children, the prevalence of the overweight 24% is worrying considering that "obesogenic" environment it will maintain and even worsen. This means that in early adulthood these children will become obese adults who will associate other cardiovascular risk factors. Not only environment but also micro-environment created at home, in families, has a great impact on the future of offspring. The family life style, including eating behavior, playing sport habit, and the time spent at TV [38] plays an important role in determining the risk for obesity [39-41]. Energy expenditure is part of the obesity equation. Any failure of energy expenditure will contribute to the development of obesity. Data suggest a reduced walking and cycling behavior and an increased using of cars to travel from home to school or to other extracurricular activities [42, 43].

Assessment of knowledge related to obesity showed that only 91/250 subjects (36,4%) had some information about obesity, causes and relation with diet and sport from online sources while 159/250 (63,6%) considered obesity more as a problem of image and not of health referring to the beauty standards offered by the media. The subjects were not concerned at all about the diet-health relation.

In conclusion, the main finding of the study is the failure of a healthy diet as the children get older. Moreover, with age, healthy diet habits seem to be lost, like cereals, fruit and vegetables consume, and high energy, sugar added products are preferred. Good alimentary habits are abandoned as the children have more independence and less parental control, and this attitude might be due to the physiological desire to assert their personality once the children get older and become adolescents but could also be a consequence of the lack of a proper medical policy of organization, education and control of children diet and aggressive food advertising. Paradoxically this failure is strong connected with school field, the place where children spend most of their time. Busy school curriculum, lack of basic nutrition and obesity information, lack of any control from parents, school and teachers of children alimentation and lack of control over food scams in the vicinity of the school where children are supplied may be the cause of poor alimentary diet. The older the children the higher preference for fast food and soft drinks. For sure there is an association between eating pattern and overweight which suggest that quick and drastic intervention should be taken as soon as possible.

Fruits dietary – all the children consume fruits.

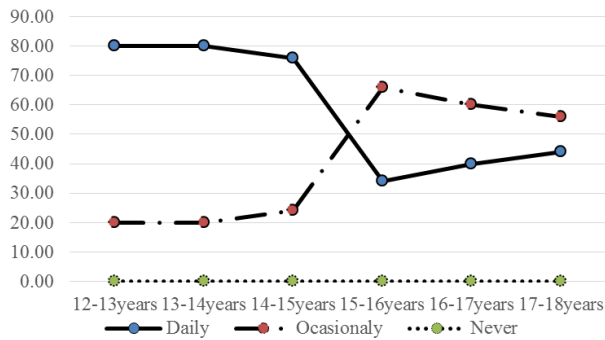


Figure 6. The fruits consume.

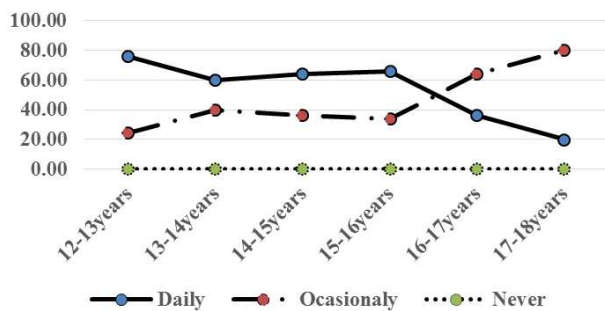


Figure 7. The vegetables consume.

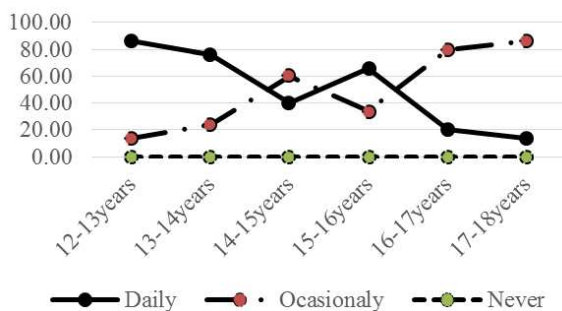


Figure 8. The cereals consume.

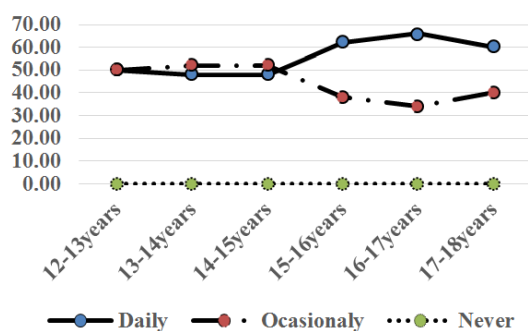


Figure 9. The fast-food consume.

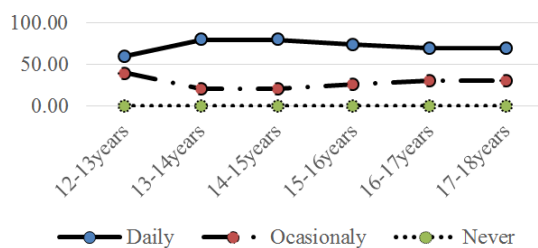


Figure 10. The beverages consume.

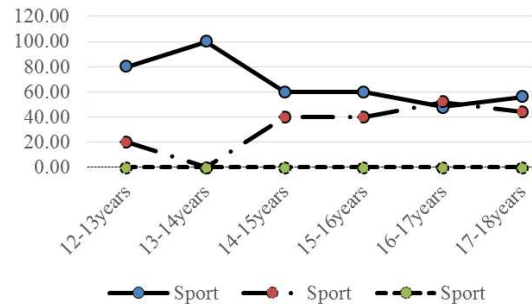


Figure 11. Sports playing.

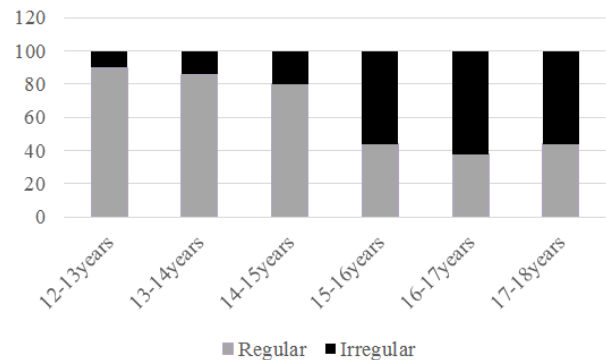


Figure 12. Meal timetable.

References

- [1] Obesity. (2000). http://ro.wikipedia.org/wiki/Obezitate#cite_note-WHO_2000_p.6-1.
- [2] Barlow SE and the Expert Committee. (2007). Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. *Pediatrics*; 120 Supplement December 2007, S164—S192.
- [3] Cote AT, Harris KC, Panagiotopoulos C, et al. (2013). Childhood obesity and cardiovascular dysfunction. *J Am Coll Cardiol*, 62 (15): 1309–1319.
- [4] Whitlock EP, Williams SB, Gold R, Smith PR, Shipman SA. (2010). Screening and interventions for childhood overweight: a summary of evidence for the US Preventive Services Task Force. *Pediatrics*, 116 (1): e125—144 external icon.
- [5] The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. (2002). *JAMA*, May, 289: 2560-2571.
- [6] Goonasekera CDA, Dillon MJ. Current topic: Measurement and interpretation of blood pressure. (2000). *Arch. Dis. Child*. 82: 261-265.
- [7] Meaney E, Samaniego V, Alva F, Valdovinos RA, Marrufo R, Vela A, Allen T, Misra A, Madsen R. (1999). Increased arterial stiffness in children with a parental history of hypertension. *Pediatr Cardiol*. May-Jun; 20 (3): 203-210.
- [8] Kishimoto C, Hirata M, Hama K, Tanaka M, Nishimura K, Kubo S, Ueda K, Fujioka T, Tamakil S. (2006). Carotid intima-media thickness is increased in subjects with ischemic heart disease having a familial incidence. *Exp Clin Cardiol*, vol 11, nr 1: 8-10.

- [9] Cuomo S, Guarini P, Gaeta G, de Michele M, Boeri F, Dorn J, Bond MG, Trevisan M. (2001). Increased carotid intima-media thickness in children-adolescents, and young adults with a parental history of premature myocardial infarction. *Eur Heart J*. 23 (17): 1345-1350.
- [10] Li S, Chen W, Srinivasan SR, Bond G, Tang R, Urbina EM, Berenson GS. (2003). Childhood Cardiovascular Risk Factors and Carotid Vascular Changes in Adulthood: The Bogalusa Heart Study. *JAMA*, 290 (17): 2271-2276.
- [11] McGill, HC, McMahan CA, Herderick EE, Malcom GT, Tracy RE, Strong JP. (2000). Origin of atherosclerosis in children and adolescence. *Am J Clin Nutr*. 72 (suppl): 1307S-15S.
- [12] Arenaza L, Medrano M, Osés M, Amasene M, Diez I, Rodríguez-Vigil B, Labayen I. (2020). The Effect of a Family-Based Lifestyle Education Program on Dietary Habits, Hepatic fat and Adiposity Markers in 8-12-Year-Old Children with Overweight/Obesity. *Nutrients*, 12, 1443; doi: 10.3390/nu12051443.
- [13] Tzou W. S., Douglas P. S., Srinivasan S. R., Bond M. G., Tang R., Chen W., Berenson G. S., Stein J. H. (2005). Increased Subclinical Atherosclerosis in Young Adults With Metabolic Syndrome: The Bogalusa Heart Study. *J. Am. Coll. Cardiol*, 46: 457-463.
- [14] Gunther C, Rogers C, Holloman C, Hopkins LC, Anderson SE, Miller CK, Copeland KA, Dollahite JS, Pratt KJ, Webster A, et al. (2019). Child diet and health outcomes of the simple supports program: A 10-week, 2-group quasi-experimental family meals trial. *BMC Public Health*, 19, 1657.
- [15] Ojeda-Rodríguez A, Zazpe I, Morell-Azanza L, Chueca M, Campoy C, Martí A. Improved Diet Quality and Nutrient Adequacy in Children and Adolescents with Abdominal Obesity after a Lifestyle Intervention. *Nutrients*, 10, 1500.
- [16] American heart Association Healthy Diet Guidelines. Available online: <https://www.cigna.com/individuals-families/health-wellness/hw/medical-topics/american-heart-association-healthy-diet-guidelines-ue4637>.
- [17] World Health Organisation Dietary Recommendations for Healthy Children. Available online: [https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/nutrition-basics/dietary-recommendations-for-healthy-children#:~:text=Children's%20recommended%20fruit%20intake%20ranges,18%2Dyear%2Dold%20boy.\(accessed on 20 February 2021\)](https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/nutrition-basics/dietary-recommendations-for-healthy-children#:~:text=Children's%20recommended%20fruit%20intake%20ranges,18%2Dyear%2Dold%20boy.(accessed on 20 February 2021)).
- [18] Chepulis, L., Everson, N., Ndanuko, R., & Mearns, G. (2020). The nutritional content of children's breakfast cereals: A cross-sectional analysis of New Zealand, Australia, the UK, Canada and the USA. *Public Health Nutrition*, 23 (9), 1589-1598. doi: 10.1017/S1368980019003537.
- [19] Lobstein T., Baur L., Uauy R. (2004). Obesity in children and young people: a crisis in public health. *The International Association for the Study of Obesity. obesity reviews* 5 (Suppl. 1), 4-85.
- [20] Bowman SA, Gortmaker SL, Ebbeling CB, Pereira MA, Ludwig DS. (2004). Effects of fast-food consumption on energy intake and diet quality among children in a national household survey. *Pediatrics*, 113: 112-118.
- [21] St-Onge MP, Keller KL, Heymsfield SB. (2003). Changes in childhood food consumption patterns: a cause for concern in light of increasing body weights. *Am J Clin Nutr*, 78: 1068-1073.
- [22] Liu J, Rehm CD, Micha R, Mozaffarian D. (2020). Quality of Meals Consumed by US Adults at Full-Service and Fast-Food Restaurants, 2003-2016: Persistent Low Quality and Widening Disparities. *The Journal of Nutrition*, Volume 150, Issue 4, April, Pages 873-883, <https://doi.org/10.1093/jn/nxz299>
- [23] Gearhardt AN, Yokum S, Harris JL, Epstein LH, Lumeng JC. (2020). Neural response to fast food commercials in adolescents predicts intake. *The American Journal of Clinical Nutrition*, Volume 111, Issue 3, March, Pages 493-502, <https://doi.org/10.1093/ajcn/nqz305>
- [24] Gregory J, Lowe S. (2000). National Diet and Nutritional Survey: Young People Aged 4-18 Years, Vol. 1: Report of the Diet and Nutrition Survey. The Stationery Office: London.
- [25] Ludwig DS, Peterson KE, Gortmaker SL. (2001). Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. *Lancet*, 357: 505-508.
- [26] Bleich, S. N., Vercammen, K. A. (2018). The negative impact of sugar-sweetened beverages on children's health: an update of the literature. *BMC Obes* 5, 6. <https://doi.org/10.1186/s40608-017-0178-9>
- [27] Razzaque MS. (2020). Overconsumption of sugar-sweetened beverages: Why is it difficult to control? *Journal of population Therapeutics & Clinical Pharmacology*. DOI: 10.15586/jptcp.v27i2.678.
- [28] Van De Gaar VM, Jansen W, Van Grieken A, Borsboom GJJM, Kremers SPJ, Raat H. (2014). Effects of an intervention aimed at reducing the intake of sugar-sweetened beverages in primary school children: A controlled trial. *Int J Behav Nutr Phys Act*, 11, 98.
- [29] World Health Organization. (2002). Report of a Joint WHO/FAO Expert Consultation. Diet Nutrition and the Prevention of Chronic Diseases. WHO Technical Report Series no. 916. WHO: Geneva.
- [30] Wolfe WS, Campbell CC, Frongillo EA Jr, Haas JD, Melnik TA. (1994). Overweight schoolchildren in New York State: prevalence and characteristics. *Am J Public Health*, 84: 807-813.
- [31] Siega-Riz AM, Popkin BM, Carson T. (1998). Trends in breakfast consumption for children in the United States from 1965 to 1991. *Am J Clin Nutr*, 67: 748S-756S.
- [32] Marmonier C, Chapelot D, Louis-Sylvestre J. (1999). Metabolic and behavioural consequences of a snack consumed in a satiety state. *Am J Clin Nutr*, 70: 854-866.
- [33] Marmonier C, Chapelot D, Louis-Sylvestre J. (2000). Effect of macronutrient content and energy density of snacks consumed in a satiety state on the onset of the next meal. *Appetite*, 34: 161-168.
- [34] Marmonier C, Chapelot D, Fantino M, Louis-Sylvestre J. (2002). Snacks consumed in a non-hungry state have poor satiating efficiency: influence of snack consumption on substrate utilization and hunger. *Am J Clin Nutr*, 76: 518-528.
- [35] da Silva MA, Rivera IR et al. (2005). Prevalence of Cardiovascular Risk Factors in Child and Adolescent Students in the City of Maceio. *Arq Bras Cardiol*, (84).
- [36] Prescott-Clarke P, Primatesta P. (1998). Health Survey for England: The Health of Young People '95-97. The Stationary Office: London.

- [37] Joo J, Williamson SA, Vazquez AI, Fernandez JR, Bray MS. (2019). The Influence of 15-week Exercise Training on Dietary Patterns among Young Adults. *Int J Obes*, 43, 1681-1690.
- [38] Lake JK, Power C, Cole TJ. (1997). Child to adult body mass index in the 1958 British birth cohort: Associations with parental obesity. *Arch Dis Child*, 77: 376–381.
- [39] Parsons TJ, Power C, Logan S, Summerbell CD. (1999). Childhood predictors of adult obesity: a systematic review. *Int J Obes*, 23 (Suppl. 8): S1–S107.
- [40] Kaplowitz HJ, Wild KA, Mueller WH, Decker M, Tanner JM. (1988). Serial and parent-child changes in components of body fat distribution and fatness in children from the London Longitudinal Growth Study, ages two to eighteen years. *Hum Biol*, 60: 739–758.
- [41] Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. (1997). Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med*, 337: 869–873.
- [42] DiGiuseppi C, Roberts I, Li L. (1997). Influence of changing travel patterns on child death rates from injury: trend analysis [published erratum appears in *BMJ*, 314: 1385]. *BMJ*, 314: 710–713.
- [43] Lantham, MD, (1997). U.S. Department of Transportation, Federal Highway Administration, Research and Technical Support Center. Nationwide Personal Transportation Survey. Federal Highway Administration.