

Dietary habits of High School Population in Mostar, Bosnia and Herzegovina

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Abstract

Background

Adolescence is a period of life when prevalence of overweight, obesity and chronic non-communicable diseases rise the fastest. This period of life is very important for adoption of healthy lifestyle habits. Those include regular physical activity and diet, which could prevent nutrient deficiencies and may limit harmful behaviors contributing to the epidemic of non-communicable diseases in adulthood. There are a small number of surveys on a large number of high school and student population about this topic in low-to middle income countries.

Methods

The aim of this study was to examine dietary habits and frequency of physical activity and presence of non-communicable diseases in immediate family. Survey was conducted in 6 secondary schools of city of Mostar through an anonymous questionnaire. The study involved 482 adolescents (279 boys and 203 girls) aged 17 and 18. For data entry and analysis SPSS (version 25) was used. Association between variables was determined using chi-square.

Results

Collected data showed low breakfast consumption by adolescents, low everyday consumption of vegetables, fruits, and dairy products. There is a high trend of daily consumption of meat, especially processed meat as also as relatively high consumption of soft drinks. In addition, data showed difference in physical activity of boys and girls.

Conclusion

There were significant deviations in dietary habits of participants compared with health needs recommended for adolescent population. Therefore, it is necessary to develop and organize better nutritional education for adolescents and involve wider community to implement public health programs in order to adopt a healthier lifestyle for adolescents.

Background

According to the Institute for Public Health of Federation Bosnia and Herzegovina (2018) top five groups of diseases that caused death of majority of populations in Bosnia and Herzegovina are, as following: disease of circulatory system, malignant neoplasms, endocrine and metabolic diseases with eating disorders. Unhealthy lifestyle, insufficient physical activity and obesity are the main factors that contribute to the above-mentioned diseases [1]. Young people are the backbone of the society. The dietary

and lifestyle habits acquired during adolescence have important repercussions on the health status in both, the short and long term [2]. Adolescence is a critical time of life. It is time when young people become independent individuals, develop social skills, create new friendships and relationships, and learn behaviors that will last the rest of their lives. In addition, they take over the responsibility for their own eating habits and health attitudes [3, 4]. It is one of the most challenging periods to experience emotional, neurological and physical transitions [2]. In that period, dietary patterns that persist through adulthood are established, impacting weight status and health risk [5]. With proper lifestyle and dietary habits, we can prevent many chronic non-communicable diseases (NCD), especially obesity, cardiovascular diseases, diabetes type 2, which are in constant rise in the whole Europe [2]. Balanced nutrition is the key for good health and sometimes cure for some diseases. In adolescence period, many young people encounter for the first time with food preparation, so they resort to unhealthy diet as fast food and food of high energy density. Also in that period, they reduce physical activity, reduce consumption of vegetables and fruits, and they usually skip breakfast and consume fewer daily meals [6]. Another problem for high school students in Mostar city is the absence of school cantina. School meals have a potential to directly affect nutrition by improving the quality of diets, including also secondary school-aged children. School meals should follow national dietary guidelines [7]. Good example for this are Finland and France [8, 9]. In Finland cross-sectional population survey aged 9 to 18 years, showed that the use of catering services is associated with healthier food habits, which are closer to nutritional recommendations compared to those not using them [8]. In absence of school canteen, young people from Mostar are forced to take a breakfast or lunch in fast food objects and bakeries around the school. That breakfast and lunch are usually nutrient-poor, energy-dense food, which leads to poor dietary habits later in life. In addition, dietary pattern, characterized by high consumption of energy-dense food, fast foods, sugar-sweetened beverages and soft drinks, as well as low fiber intake, appears to contribute to an increase in body fat in early adulthood [10].

Aim of this research is to reveal dietary habits and frequency of physical activity of scholars of different schools in city of Mostar in accordance to gender and to examine their knowledge about proper nutrition and food pyramid.

Methods

Survey was conducted in November 2019, in 6 secondary schools of the city of Mostar through an anonymous questionnaire entitled "Estimation of the Eating Habits of High School Students in the City of Mostar". The respondents were young people aged 17 and 18. The survey included 482 high school students (279 boys and 203 girls). Distribution by age and gender is shown in Table 1. First part of the survey contained questions on general characteristics of study population, i.e. gender and age, whilst second part contained 18 questions about dietary habits and food preferences, question about physical activity, about frequency of non-communicable diseases in their close family, and question about presence of allergy or food intolerance.

Table 1
Distribution by age and gender

			Age		Total
			17	18	
Gender	Male	Count	152	127	279
		% within Gender	54.5%	45.5%	100.0%
	Female	Count	90	113	203
		% within Gender	44.3%	55.7%	100.0%
Total	Count		242	240	482
	% within Gender		50.2%	49.8%	100.0%

Statistical analysis

The obtained data were processed by using IBM SPSS Statistics 25 for Windows and Microsoft Excel (version Office 2016, Microsoft Corporation, Redmont, WA, USA). Chi square test was used for a difference in frequency of consumption of certain food groups between gender. Statistical tests were regarded as statistically significant if p value was < 0.05 .

Results

The obtained results showed adequate knowledge of understanding terms “nutrition” and “Food pyramid”, 88.6% and 95.6% respectively (Table 2, Table 3). Girls showed better knowledge than boys for both terms, and difference between genders is statistically high significant.

Table 2
Distribution by gender about term “nutrition”

			Are you familiar with the term "nutrition"?		Total
			Yes	No	
Gender	Male	Count	238	41	279
		% within gender	85.3%	14.7%	100.0%
	Female	Count	189	14	203
		% within gender	93.1%	6.9%	100.0%
Total	Count		427	55	482
	% within gender		88.6%	11.4%	100.0%

$(\chi^2 = 7.070; df = 1; p = 0.008)$

Table 3
Distribution by gender about term "food pyramid"

		Are you familiar with the term "food pyramid"?			Total
			Yes	No	
Gender	Male	Count	261	18	279
		% within gender	93.5%	6.5%	100.0%
	Female	Count	200	3	203
		% within gender	98.5%	1.5%	100.0%
Total		Count	461	21	482
		% within gender	95.6%	4.4%	100.0%

$(\chi^2 = 6.976; df = 1; p = 0.008)$

The majority of participants, 373 of them (77.4%) have 3 to 5 meals per day Fig. 1. Mostly male students, 223 (79.9%) have regularly 3 to 5 meals per day in comparison with 150 of women students (73.9%). However, there is no statistical significance between gender and daily number of meals ($\chi^2 = 3.31; df = 2; p = 0.191$).

Breakfast is consumed regularly by 35.7% of participants (Table 4). There is statistical significance between gender ($\chi^2 = 6.090; df = 2; p = 0.048$) in breakfast consumption. Females are less likely to consume breakfast regularly, half to one hour after waking up, than boys (29.6% vs 40.1% respectively).

Table 4
Consumption of breakfast between genders in studied population

		Do you regularly eat breakfast (half to one hour after waking up)?			Total	
			Yes	No	Rarely	
Gender	Male	Count	112	85	82	279
		% within gender	40.1%	30.5%	29.4%	100.0%
	Female	Count	60	68	75	203
		% within gender	29.6%	33.5%	36.9%	100.0%
Total		Count	172	153	157	482
		% within gender	35.7%	31.7%	32.6%	100.0%

Both genders (163 of males and 90 of females which is 52.5%) drink adequate amount of water (1.5 to 2 liters per day) (Fig. 2), and 25.5% of both genders drink less than 1 liter (27 of males and 96 of females), while 22% drink 3 liters or more. Difference between genders is highly significant ($\chi^2 = 99.158$; $df = 2$; $p = 0.000$).

Besides water, for beverages 46.3% of all respondents consume regularly soft drinks (47.7% of boys and 44.3% of girls), carbonated and non-carbonated, while 13.3% of boys and 13.8% of girls do not consume it at all. Boys consume soft drinks more often than girls, but it is not statistically significant difference. ($\chi^2 = 0.537$; $df = 2$; $p = 0.765$).

The percentage of students who consume cereals and whole cereal products every day is quite low and it is 12.9%. Students who consume this food 1 to 2 times per week is 17.8%, 51% of students take it rarely (less than 1 times per week) and even 18.3% of them have never consumed whole cereals products. Girls were less likely to consume whole cereals and their products than boys (Fig. 3) but it is not statistically significant difference ($\chi^2 = 1.592$; $df = 3$; $p = 0.661$).

Vegetables are consumed on daily basis by 35.1% of adolescents (36.9% boys vs. 32.5% girls), and 12.7% of them consume vegetables rarely (less than 1 time per week). In comparison with vegetables, fruits are consumed by 48.1% of adolescents every day (49.1% boys vs. 46.8% girls) and 10.2% of them consume fruit rarely (less than 1 time per week).

For vegetables ($\chi^2 = 1.243$; $df = 2$; $p = 0.537$) and fruits ($\chi^2 = 0.253$; $df = 2$; $p = 0.881$) consumption there is no significant difference between males and females. Dairy products are consumed daily by 66.6% of adolescents, 68.5% boys and 64% girls ($\chi^2 = 1.333$; $df = 2$; $p = 0.513$). There is a link of consumption between gender within this food category.

Table 5

Frequency of consumption of selected foods in the studied adolescent population by gender and in total

		Gender					
		Male		Female		Total	
		Count	%	Count	%	Count	%
Vegetables	Every day	103	36.9%	66	32.5%	169	35.1%
	1 to 3 times per week	140	50.2%	112	55.2%	252	52.3%
	Rarely	36	12.9%	25	12.3%	61	12.7%
Fruits	Every day	137	49.1%	95	46.8%	232	48.1%
	1 to 3 times per week	114	40.9%	87	42.9%	201	41.7%
	Rarely	28	10.0%	21	10.3%	49	10.2%
Dairy products	Every day	191	68.5%	130	64.0%	321	66.6%
	1 to 3 times per week	74	26.5%	59	29.1%	133	27.6%
	Rarely	14	5.0%	14	6.9%	28	5.8%
Red meat	Every day	75	26.9%	31	15.3%	106	22.0%
	1 to 3 times per week	181	64.9%	134	66.0%	315	65.4%
	Rarely	23	8.2%	38	18.7%	61	12.7%
Processed meat	Every day	48	17.2%	20	9.9%	68	14.1%
	1 to 3 times per week	126	45.2%	84	41.4%	210	43.6%
	Rarely	105	37.6%	99	48.8%	204	42.3%

Most of the participants (65.4%) consume red meat 1 to 3 times per week, while 22% of participants eat meat every day, 12.7% of them eat meat rarely (less than 1 times per week). Boys are more likely to eat meat every day. Difference between genders is highly significant ($\chi^2 = 17.415$; $df = 2$; $p = 0.000$). Besides meat, 14.1% of participants consume processed red meat every day, 43.6% of them consume 1 to 3 times per week, what is quite often. Less than 1 times per week, consume 42.3% of adolescents. Daily consumers are mostly boys (17.2%), while 9.9% are girls. Difference between genders is significant ($\chi^2 = 8.330$; $df = 2$; $p = 0.016$). Figure 4 shows consumption of different types of oils and fats between adolescents. It is visible that they prefer butter (29%), olive oil (21.4%) is on the second place and followed by refined vegetable oil (19.3%), other type of oil/fat (coconut oil, animal fat) (18%), and margarine (12.2%). ($\chi^2 = 15.083$; $df = 4$; $p = 0.005$). Difference between genders is highly significant. Boys prefer butter and other types of oil/fat, and girls prefer more refined vegetable oil and margarine.

Out of all of all adolescent, 33.2% have in their immediate family someone with NCD (23.7% of males and 46.3% of females). As visible, difference between genders is highly significant ($\chi^2 = 27.182$; $df = 1$; $p = 0.000$). In addition, we investigate allergy or food intolerance of study population. 10% of all participants have some allergy or food intolerance. Analysis of collected data shows statistical significance in the presence of allergy or food intolerance between genders ($\chi^2 = 4.368$; $df = 1$; $p = 0.037$). 13.3% of girls and 7.5% of boys answered affirmative.

Out of all participants (N = 482) only 1 boy was vegan, and 1 girl followed vegetarian diet. 12.9% participants answered that follow some other “special diet”, mostly boys (43 of them) and 19 girls, so there is highly significant difference between genders ($\chi^2 = 5.923$; $df = 3$; $p = 0.115$). Specific reduction diets are also very often among adolescence, and could lead to eating disorders (WHO, 2018). Answer to question “Have you been on some reduction diet for the past year?” 18.2% of girls and 11.8% of boys answered affirmative ($\chi^2 = 3.876$; $df = 1$; $p = 0.049$). Difference between genders is significant.

Together with dietary habits, the practice of physical activity is another important factor to reduce risk of NCD. In this survey, boys do physical activity more often than girls do, which is visible in Table 6. Difference between genders is highly significant ($\chi^2 = 49.077$; $df = 2$; $p = 0.000$).

Table 6
Frequency of physical activity in studied adolescent population

		Gender	
		Male	Female
How often you do physical activity?	Very often	221	99
	Rarely	49	91
	Never	9	13
	Total	279	203

Discussion

Results from this research are similar to those from studies done in neighborhood countries [3, 11, 6, 12, 13] probably due to the similar geographical, social and cultural characteristics. In addition, comparison with some larger health and nutrition surveys [14, 15] is possible even though Bosnia and Herzegovina belongs to low-to middle income countries.

Since the study population was mature enough (17 and 18 years old), they showed good knowledge about nutrition and related terms as expected. Results are in accordance with similar research [3] where girls also showed better knowledge.

According to guidelines for adolescence, adolescents should have 5 to 6 meals per day (3 main meals and 2 to 3 snacks) to ensure adequate amount of energy for all daily activities. When an adolescent's overall energy and nutrient needs are not met, linear growth may be slowed, stunting may occur, and sexual development and menarche may be delayed [2]. Out of all participants, 77.4% have 3 to 5 meals per day. This finding is consistent with those of other studies on similar population. In research [11] on student population in the city of Mostar, most common response was 3 to 5 meals per day between participants (48.63%, of which 49.32% of males and 38.36% of females). We observed similar difference in genders results (Fig. 1). But overall results are better in this research. Reason could be in age difference between studied population, where respondents from research of Banožić et al. [11] are university population in Mostar, with different obligations during the day. Results from this research are more similar to the results of the cross-sectional AVENA study, which included 1978 adolescents from five Spanish cities. Results from AVENA study show that 80.4% of boys and 75.9% of girls have four or more meals during the day. This study also showed that adolescents eating more than four meals per day had lower skin folds and waist circumference [14]. A several observational studies showed a consistent association of skipping meals with increased obesity risk in children [16]. Therefore, increasing meal frequencies to 5 per day with adequate nutrition quality could be a possible target for early prevention of overweight and obesity, and consequently chronic non-communicable diseases [16].

Relatively low percent of students (35.7%) does not consume breakfast half to one hour after waking up regularly (Table 4). That is in accordance with results of [13] research on 229 high school students between 15 and 18 years old at Travnik also in Bosnia and Herzegovina. In that research 37.78% of males and 32.37% of girls does not consume breakfast regularly. In another research in Banja Luka, Bosnia and Herzegovina [12] only 25% of 119 high school students breakfasting on regular basis. Research [3] on 117 adolescents shows that 36.8% of high school students from continental part of Croatia skip the breakfast. According to some researches, breakfast consumption has been associated with improved cognitive performance, tend to lower body mass index (BMI), bone and cardiovascular health of eaters, and exhibit a healthy weight control than at breakfast skippers. Conversely, breakfast skippers tend to have higher BMI, poorer food choices and greater energy intake from snacks [17, 18, 19]). In the large Iranian study of 78,905 university students aged 18 years and older, male students who consumed breakfast frequently had higher intake of fruits, dairy, and lower intake of fast foods and carbonated beverages than those who consumed it infrequently [20].

Conclusion from the Third National Health and Nutrition Examination Survey [18] was that not only breakfast consumption itself is associated with BMI, but also the type of food eaten for breakfast, affects BMI. Eating cereals or quick breads for breakfast is associated with significantly lower body mass index compared to skipping breakfast or eating meats or eggs.

An adequate intake of water for 17 and 18 years old boys and girls is 2 liters per day, including drinking mineral water and water contained in food [21]. That is the same as for adults older than eighteen. Water is a nutrient essential for life and health. Even minor losses can have adverse effects on body thermoregulation and physical activity capacity, feelings of fatigue, concentration and alertness and

cognitive function [22], what is especially important for school children and students. The results for water intake between genders are very similar to the results [11] and for high school population in Serbia, Belgrade [6] where 45% of boys and 47% of girls drink 1 to 1.5 L of water per day. According to [11], girl teenagers consume in average smaller amount of water than boys. The most common response, in this survey, between girls (47.3%) was 0.5-1 liter per day, what is equivalent to 6 glasses of water, and the most common response between boys (58.4%) was 1.5-2 liters per day what is equivalent to 8 glasses. This may be due to different physical needs for water between genders. According to this survey, girls are less physically active than boys so explanation could be find in their lower needs for water.

Consumption of soft drinks is in accordance with other surveys on similar population [11, 13]. According to [3] on high school population in Vinkovci, Croatia boys consumed soft drinks more often than girls (47.7% vs. 36.1%), as in this research (47.7% of boys vs. 44.3% of girls). Regular intake of soft drinks increase energy intake, what can contribute to obesity and risk of NCD. Findings from well-powered prospective cohorts have consistently shown a significant association and a direct dose–response relationship between sugary beverages consumption and long-term weight gain and risk of type 2 diabetes [23]. Calorically sweetened beverages contribute to obesity through their caloric load, because intake of sugary beverages or beverages with high-fructose corn syrup does not produce a corresponding reduction in the intake of other food, so beverage calories are “add-on” calories. Soft drinks have also been implicated in the risk of the development non-alcoholic fatty liver disease and insulin resistance [24]. This is a reason why mineral water needs to be the first choice for children and adolescents to quench thirst.

Cereals and cereal products were rarely eaten (51% of participants eat less than one time per week) (Fig. 3) and that finding is consistent with similar study [13]. Among 229 participants aged 15 to 18 years, there was 30.1% of students who never consumed cereals, 31.9% of them consume it 1 time per week, 18.3% 2 to 4 times per week, and 19.7% for 1 and few times every day [13]. Question about whole grain consumption, was not included in other similar surveys done in Bosnia and Herzegovina. Most data come from US but it was also including in some survey in Europe. For example, in large Italian INHES study on sample of 561 children and adolescents (5–19 years old), 62.6% of all girls and boys were non-consumers of whole grain food, 15.5% were occasional consumers (< 1 time/ week) while 21.9% were regular consumers (≥ 1 time/week) [15]. In the UK 15% of children and teenagers do not consume whole grain at all, and in Germany for the same population that is 19% [25]. In numerous epidemiological studies consumption of whole grain products is associated with lower risk of chronic diseases such as coronary heart disease, stroke, diabetes type 2 and colorectal cancer. It also has positive health benefits through regulating blood pressure, insulin sensitivity and plasma cholesterol [15]. The Mediterranean diet pyramid recommends the consumption of one or two serving of cereals at each meal, in the form of bread, pasta, rice, couscous but preferably whole grain. Taking into consideration that whole grain products have higher levels of dietary fibers, vitamins (B vitamins), minerals (zinc, phosphorus, magnesium, iron) and bioactive compounds such as antioxidants and other phytochemicals, they must be included in adolescent`s daily diet. Foods high in dietary fibers, such as whole grain cereals and

vegetables, can promote satiety and therefore may have influence in weight regulation by improving appetite regulation and tending to constrain excess energy consumption during the day [25].

Having in mind recommendations for vegetables and fruits consumption (5 portions of 400 g a day) results are not satisfactory (Table 5). In similar research [12] on 119 students in another city in Bosnia and Herzegovina, 39.5% of participants consumed vegetables once a day, 23.5% twice a day and 10.9% 3 times a day. Considering fruits consumption, 22.7% of participants consumed fruit once a day, 31.3% twice and 16.8% three times daily in the same study. In study [11] the most common response for consumption vegetables and fruits was 2 to 4 times per week, for both males and females. Vegetables and fruits supply vitamins and minerals to the diet as also dietary fiber, phytochemicals that function as antioxidants, phytoestrogens, and anti-inflammatory agents and through other protective mechanisms. Therefore consumption of vegetables and fruits is linked to lower incidence of chronic diseases [26].

Analysis of the collected data, shows that 66% of adolescents consume dairy products every day. The similar results are obtained in the study [12] where 59.7% of adolescent population consumes milk and dairy products on a daily basis. Products as milk, yogurt and cheese should be on a daily menu of young boys and girls. Recommendations are approximately three to five servings per day for adolescents, encouraging low-fat dairy products. Decreased milk consumption negatively influences calcium and vitamin D intake, which are important for bone development, dental integrity and maintenance of healthy body composition [27].

Regarding adolescent's consumption of red meat results are not wanted (Table 5). Similar to the study [12], adolescents have dietary preferences to consume red meat mostly up to 3 times per week. For children, meat is important source of valuable proteins, vitamins A, B₁, B₁₂ and niacin, iron, zinc and other micronutrients [28]. For adolescents aged 17 and 18, recommendations as for adult healthy population could be applied. Evidence from last decade point out connection between increased consumption of red meat, especially in its processed forms and health effects, especially for cardiovascular and cerebrovascular health [28]. In most cases, the muscle meat from beef, veal, pork, lamb, venison is defined as "red" meat. Recommendation is also to moderate consumption of processed meats because these are high in fat and salt, classified as Group 1 carcinogens for humans, based on epidemiological studies. The strongest, but still limited, evidence suggest that eating processed meat causes colorectal cancer, and some evidence links it with pancreatic and prostate cancer [29, 30].

Considering that 33.2% of young participants have someone in immediate family with some chronic non-communicable disease (DMT2, hypertension, or some other cardiovascular disease) more attention should be paid on consumption of this food group, but also for group of oils and fats. Very large percent of adolescents prefer butter, which is saturated fat, and can influence a total cholesterol level in blood and consequently have association with NCD. According to Mediterranean diet, mono and polyunsaturated fatty acids (olive oil) reduce blood cholesterol level and risk of heart diseases when they substitute one portion of saturated fatty acids in the diet. Consumption of olive oil reduces LDL cholesterol simultaneously affecting HDL cholesterol [31].

Since 12.9% participants answered that follow some other “special diet”, mostly boys, we supposed that maybe they followed some ketogenic diet (because of popularity and more physical activity), but more detailed survey should be carried out to confirm this.

Girls are more susceptible to reduction diets in this survey as also in similar survey [3]. Also interesting facts are that girls had more allergy or food intolerance than boys. There are no such results from similar researches from neighbor countries but there is also a small number of other studies about allergy or food intolerance prevalence in adolescent population. Conclusion, from the Isle of Wight Birth Cohort (n = 1456) on prevalence and longitudinal trends of a food allergy, is that food allergy is highly prevalent in infancy with partial resolution during late childhood. A number of children acquire new food allergy during adolescence, resulting in a relatively higher prevalence at 18 years [32]. That newly acquired allergy is often result of primary sensitization to inhalant allergens with subsequent sensitization to cross-reactive allergens in food [33]. Since this was in the form of single question in this survey, further investigation about type of allergy and intolerance is needed.

Boys are physically more active than girls (Table 6), which was also showed in other studies [14, 6]. In above-mentioned AVENA study connection between physical activity and obesity development was shown [14].

Limitations of The Study

There was any question about consumption of fish and student’s preferences about it. That is extremely important in adolescent’s diet and for assessment of their dietary habits.

Conclusion:

Knowledge about nutrition has a direct impact on dietary preferences and choices. The overall results suggest the need to develop programs for promotion of healthy lifestyle among adolescents. A special attention should be paid to promote intake of vegetables and fruits and discourage intake of energy-dense micronutrient-poor foods and sugar sweetened beverages. A healthy and maintained diet and regular physical activity could be an effective strategy for the prevention of NCD and obesity. Therefore, survey results were presented on 12.12.2019. in the amphitheater of the Faculty of Agriculture and Food Technology, University of Mostar in front of 97 students of high schools. The remainder consisted of professors, pedagogues and students of the Faculty of Agriculture and Food Technology (32) followed by education about the importance of proper nutrition. The purpose was to inform the present respondents, their parents and teachers, about the importance of improving eating and living habits.

Abbreviations

NCD:chronic non-communicable disease; DMT2:diabetes mellitus type 2; LDL:Low-density lipoprotein

Declarations

Ethics approval and consent to participate

Verbal informed consent was obtained from all participants, and all participants were selected randomly. This study was conducted as an extracurricular activity, as part of the Civitas project of high school students of High Medical School Sestre milosrdnice Mostar in collaboration with Faculty of Agriculture and Food Technology, University of Mostar.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

Fundings

The research was funded by the authors.

Authors' contributions

NC and AJ conceived the original concept of the study and designed the research methodology. AT and LV carried out the questionnaires and helped in data analysis together with ZK. NC wrote the paper with close supervision from AJ. All authors read and contributed to the reviewing the data analysis, designing the manuscript, and approval of the final manuscript.

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References

- [1] Institute for Public Health of Federation Bosnia and Herzegovina (ZZJZ) Population health and health care in the Federation of Bosnia and Herzegovina. Sarajevo; 2019. <https://www.zzjzfbih.ba/wp-content/uploads/2020/01/Zdravstveno-stanje-stanovnistva-2018>
- [2] WHO World Health Organization. Guideline: implementing effective actions for improving adolescent nutrition. Geneva: World Health Organization; 2018. <https://apps.who.int/iris/bitstream/handle/10665/260297/9789241513708-eng.pdf;jsessionid=4D5C684A466B656>
- [3] Milosavljević D, Mandić ML, Banjari I. Nutritional knowledge and dietary habits survey in high school population. *Coll Antropol.* 2015;39:101-7. <https://www.ncbi.nlm.nih.gov/pubmed/26040077>
- [4] Moreno LA, Kersting M, De Henauw S, Gonzalez-Gross M, Sichert-Hellert W, Matthys C, Mesana MI, Ross N. How to measure dietary intake and food habits in adolescence: the European perspective. *Int J Obes.* 2005;29:S66-77. <https://doi.org/10.1038/sj.ijo.0803063>
- [5] Hu T, Jacobs Jr DR, Larson NI, Cutler GJ, Laska MN, Neumark-Sztainer D. Higher diet quality in adolescence and dietary improvements are related to less weight gain during the transition from adolescence to adulthood. *J Pediatr.* 2016;178:188-93. <https://doi.org/10.1016/j.jpeds.2016.08.026>
- [6] Djordjevic-Nikic M, Dopsaj M. Characteristics of eating habits and physical activity in relation to body mass index among adolescents. *Journal of the American College of Nutrition.* 2013;32:224-33. <http://dx.doi.org/10.1080/07315724.2013.791149>.
- [7] Hunter D, Giyose B, PoloGalante A, Tartanac F, Bundy D, Mitchell A. Schools as a System to Improve Nutrition: A new statement for school-based food and nutrition interventions. United Nations System Standing Committee On Nutrition. 2017. (<https://gcnf.org/wp-content/uploads/2018/03/UNSCN-Schools-as-a-System-to-Improve-Nutrition-Sep-2017.pdf> accessed 2 April, 2020)
- [8] Raulio S, Roos E, Prättälä R. School and workplace meals promote healthy food habits. *Public Health Nutr.* 2010;13:987-92. <https://doi.org/10.1017/S1368980010001199>.
- [9] Dubuisson C, Lioret S, Dufour A, Calamassi-Tran G, Volatier JL, Lafay L, Turck D. The relationship between school lunch attendance and the food intakes of French school children aged 3–17 years. *Public Health Nutr.* 2015;18:1647-57. <https://doi.org/10.1017/S1368980014002900>
- [10] Schneider BC, Dumith SC, Orlandi SP, Assunção MC. Diet and body fat in adolescence and early adulthood: a systematic review of longitudinal studies. *Cienc Saude Coletiva.* 2017;22:1539-52. <https://doi.org/10.1590/1413-81232017225.13972015>
- [11] Banožić M, Ljubić A, Pehar M, Ištuk J, Čačić Kenjerić D. Dietary habits of students of the University of Mostar. *Food in health and disease: scientific-professional journal of nutrition and dietetics.* 2015;4:105-12. <https://hrcak.srce.hr/152218>
- [12] Lošić D, Čačić Kenjerić D. Does knowledge influences our diet? Dietary habits of adolescents enrolled in general profile and catering school program. *Food in health and disease: scientific-professional journal of nutrition and dietetics.* 2015;4:98-104. <https://hrcak.srce.hr/152216>
- [13] Kukić E, Karakaš S, Paklarčić M. Differences in eating habits among students aged 15-18 years in relation to sex in the area of municipality Travnik. *Food in health and disease: scientific-professional journal of nutrition and dietetics;* 2016;5(1):6-14. <https://pdfs.semanticscholar.org/4bea/a139aedf64ecae5042245d661c52c0722d69.pdf>

- [14] Gómez-Martínez S, Martínez-Gómez D, de Heredia FP, Romeo J, Cuenca-García M, Martín-Matillas M, Castillo M, Rey-López JP, Vicente-Rodríguez G, Moreno L, Marcos A. Eating habits and total and abdominal fat in Spanish adolescents: influence of physical activity. The AVENA study. *Journal of Adolescent Health*. 2012;50:403-9. <https://doi.org/10.1016/j.jadohealth.2011.08.016>
- [15] Ruggiero E, Bonaccio M, Di Castelnuovo A, Bonanni A, Costanzo S, Persichillo M, Bracone F, Cerletti C, Donati MB, de Gaetano G, Iacoviello L. (2019) Consumption of whole grain food and its determinants in a general Italian population: Results from the INHES Study. *Nutr Metab Cardiovasc Dis*. 2019;29:611-20. <https://doi.org/10.1016/j.numecd.2019.03.001>
- [16] Koletzko B, Toschke AM. Meal patterns and frequencies: do they affect body weight in children and adolescents? *Crit Rev Food Sci Nutr*. 2010;50:100-5. <https://doi.org/10.1080/10408390903467431>
- [17] Wang S, Schwartz MB, Shebl FM, Read M, Henderson KE, Ickovics JR. School breakfast and body mass index: a longitudinal observational study of middle school students. *Pediatr Obes*. 2017;12:213-20. <https://doi.org/10.1111/ijpo.12127>
- [18] Cho S, Dietrich M, Brown CJ, Clark CA, Block G. The effect of breakfast type on total daily energy intake and body mass index: results from the Third National Health and Nutrition Examination Survey (NHANES III). *J A Coll Nutr*. 2003;22:296-302. <https://doi.org/10.1177/1010539516647774>
- [19] Sandercock GR, Voss C, Dye L. Associations between habitual school-day breakfast consumption, body mass index, physical activity and cardiorespiratory fitness in English schoolchildren. *Eur J Clin Nutr*. 2010;64:1086-92. <https://doi.org/10.1038/ejcn.2010.145>
- [20] Mansouri M, Hasani-Ranjbar S, Yaghubi H, Rahmani J, Tabrizi YM, Keshtkar A, Varmaghani M, Sharifi F, Sadeghi O. Breakfast consumption pattern and its association with overweight and obesity among university students: a population-based study. *Eat Weight Disord*. 2018;9:1-9. <https://doi.org/10.1177/003335491012500402>
- [21] EFSA European Food Safety Authority Dietary reference values: interactive tool. 2018 (<http://www.efsa.europa.eu/en/interactive-pages/drvs>, accessed 19 February 2020).
- [22] Aphas G, Stavrinou PS, Andreou E, Giannaki CD. Hydration status, total water intake and subjective feelings of adolescents living in a hot environment, during a typical school day. *Int J Adolesc Med*. 2019; 0(0). <https://doi.org/10.1515/ijamh-2018-0230>
- [23] Hu FB. Resolved: there is sufficient scientific evidence that decreasing sugar-sweetened beverage consumption will reduce the prevalence of obesity and obesity-related diseases. *Obes rev*. 2013;14:606-19. <https://doi.org/10.1111/obr.12040>
- [24] Bray, George A. Energy and fructose from beverages sweetened with sugar or high-fructose corn syrup pose a health risk for some people. *Adv Nutr*. 2013;4:220-225. <https://doi.org/10.3945/an.112.002816>
- [25] EUFIC Whole grains. 2015. (<https://www.eufic.org/en/whats-in-food/article/whole-grains-updated-2015> accessed 4 March 2020)
- [26] Slavin, JL, Lloyd B. Health Benefits of Fruits and Vegetables. *Adv Nutr*, 2012;3, 506– 516. <https://doi.org/10.3945/an.112.002154>
- [27] Dror DK, Allen LH. Dairy product intake in children and adolescents in developed countries: trends, nutritional contribution, and a review of association with health outcomes. *Nutr Rev*, 2014;72:68-81.

<https://doi.org/10.1111/nure.12078>

[28] Richi EB, Baumer B, Conrad B, Darioli R, Schmid A, Keller U. Health risks associated with meat consumption: a review of epidemiological studies. *Int J Vitam Nutr. Res.* 2015;85:70-8.

<https://econtent.hogrefe.com/doi/pdf/10.1024/0300-9831/a000224>

[29] WHO World Health Organization. Q&A on the carcinogenicity of the consumption of red meat and processed meat. Geneva: World Health Organization; 2015. (<https://www.who.int/features/qa/cancer-red-meat/en/> accessed 9 March, 2020)

[30] Domingo JL, Nadal M. Carcinogenicity of consumption of red meat and processed meat: A review of scientific news since the IARC decision. *Food Cheml Toxicol.* 2017;105:256-61.

<https://doi.org/10.1016/j.fct.2017.04.028>

[31] Banjari I, Bajraktarović-Labović S, Misir A, Huzjak B. Mediterranean diet and cardiovascular diseases. *Tim Med Gazette* 2013;38:196-202. <http://tmg.org.rs/TMG-v3804.pdf#page=39>

[32] Venkataraman D, Erlewyn-Lajeunesse M, Kurukulaaratchy RJ, Potter S, Roberts G, Matthews S, Arshad SH. Prevalence and longitudinal trends of food allergy during childhood and adolescence: results of the Isle of Wight Birth Cohort study. *Clin Exp Allergy*, 2018;48:394-402.

<https://doi.org/10.1111/cea.13088>

[33] Ballmer-Weber BK. Food Allergy in Adolescence and Adulthood. In: *Food Allergy: Molecular Basis and Clinical Practice*. S. Karger AG; 2015;51–8. <http://dx.doi.org/10.1159/000371669>

Figures

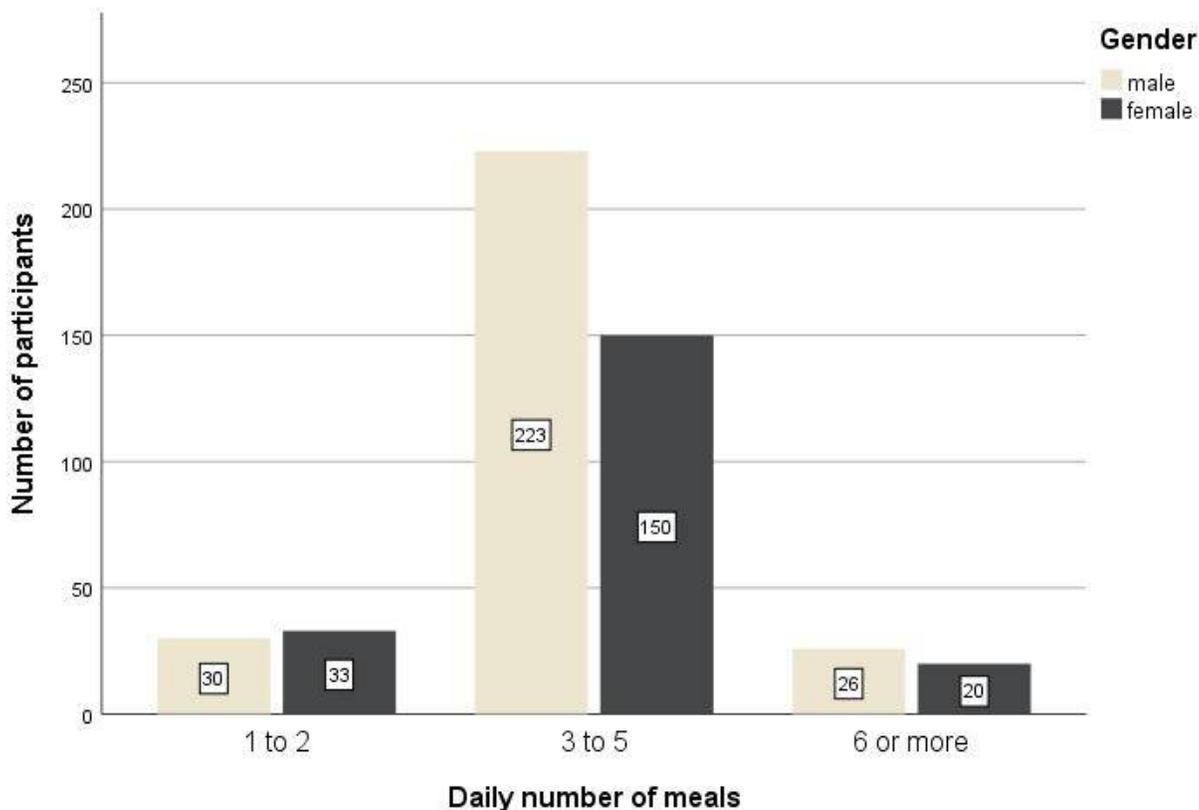


Figure 1

Daily numbers of meals between genders in the studied population

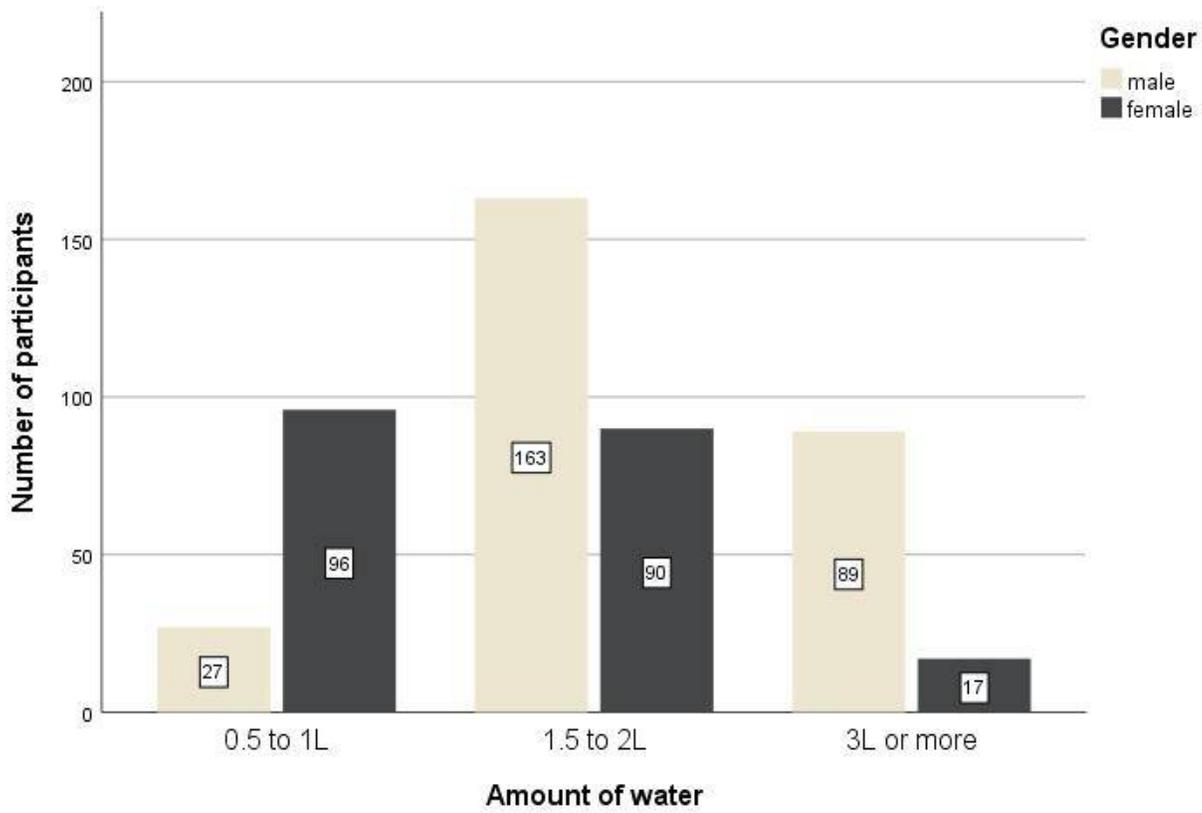


Figure 2

Daily intake of water between male and female students

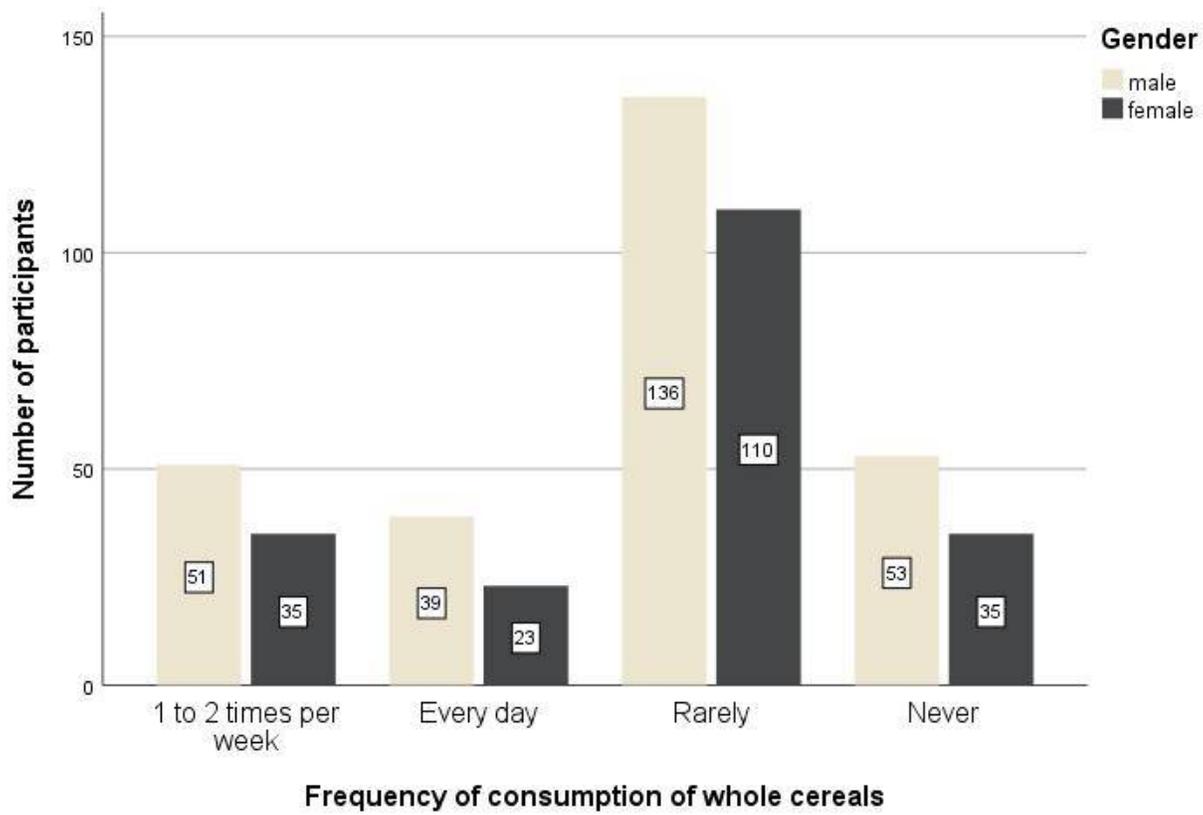


Figure 3

Frequency of consumption of whole cereals and their products by gender

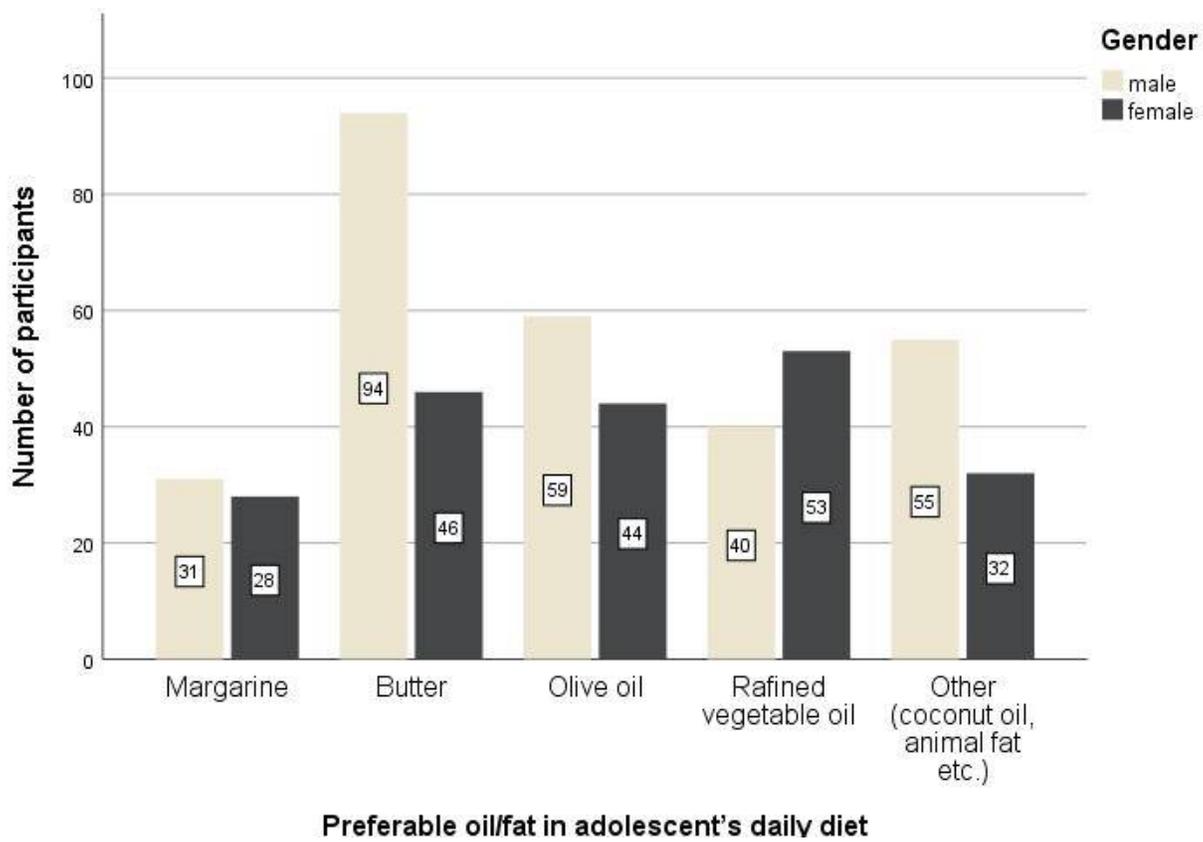


Figure 4

Preferable oil/fat in adolescent's daily diet