

## Study on the evaluation and optimization of the high school students' menu

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### Abstract

The objective of the study was to analyze from a nutritional and energetic point of view the weekly menu practiced in the canteen of a national college from Slobozia city, Romania, and its optimization in order to ensure a balanced diet for students. The research was carried out, in the first phase, based on the analysis of the nutritional and energetic value of the menu and the next phase consisted of conducting an opinion poll based on a questionnaire, which aimed to analyze students' food preferences. The weekly average energy value of the menu served at the school canteen is 2893.81 kcal / day, a value that covers the energy needs of girls, but for boys it is insufficient. Education is a very important factor that influences healthy eating and plays an important role in establishing appropriate eating behavior of the adolescents.

**Keywords:** diet, nutritional value, energy value, food rations

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### 1. Introduction

Adolescence is one of the most challenging periods of human development during which take place the modelling of the future adult. In recent years, there has been a strong emphasis on improving the diet and lifestyle of children and adolescents, as part of a comprehensive strategy to prevent obesity and chronic diseases such as cardiovascular disease, type 2 diabetes and osteoporosis [1, 2]. This was determined by the fact that many chronic diseases have their roots in the early years [3] and healthy behaviors in childhood and adolescence become models of later life [4]. The analysis of children's eating habits revealed that the consumption of sweetened soft drinks, sweets, salty snacks, candies, desserts and high-fat products were associated with the high incidence of obesity [5], not only in developed countries but also in middle and low-income countries [6, 7]. In Romania, adolescent obesity, although still below the EU average, has doubled in the last decade, from 7% in 2005-2006 to 14% in 2013-2014 [8].

It must not forget that all these diseases and deficiencies of the level of physical development have a great impact on the children's ability to adapt to effort, so with major implications on the educational process and especially on the results obtained by students in it. All children and young people diagnosed with chronic diseases must be properly treated in order to avoid complications and sequelae, in order to fully recover them. Studies which evaluated the promotion of healthy diets in children, using schools as platforms, concluded an increased parental involvement in ensuring the quality and caloric value of adolescents' diet by implementing changes in their menu and children's eating habits [9, 10]. Moreover, it was highlighted that school meals are a way for children to adopt a healthy and sustainable diet [11, 12] which can continue throughout life. Therefore, in order to better understand this phenomenon, the aim of this study was to evaluate the factors involved in the eating behavior of adolescents and thus to be able to increase the nutritional value of the school meals.

## 2. Materials and Method

In order to evaluate the menu for the students from a national college of Slobozia city, Romania, and to be able to make decisions on its optimization, but especially to take measures to raise awareness among students about the influence of nutrition on their development, a survey was used opinion conducted using a questionnaire designed to analyze their food preferences and consequently the possible food deviations. Therefore, the research was carried out in two phases: the first phase, based on the analysis of the nutritional and energetic value of the menu and the next phase consisted of conducting an opinion poll based on a questionnaire, which aimed to analyze students' food preferences. The study was conducted using the online platform [13] survey based on a standardized questionnaire on a strictly defined exhaustive collectivity and the interpretation and centralization of the collected data was done with the help of the online questionnaire platform [14]. Therefore, the study was conducted on a sample of 100 students in grades IX - XII from a national college in Slobozia, Romania, during April 2020. The researched community consisted of 100 students, aged between 14 and 19, 19 boys and 81 girls. The environment of residence of the respondents was predominantly urban, 66%, the remaining 34% coming from rural areas.

## 3. Results and Discussion

In order to optimize the school menu, it was analyzed the real ration of the adolescent in the daily menu by reference to the recommended ration. The food ration is the amount of food that provides the necessary nutrients and caloric energy of an individual in 24 hours. Calorie requirement depends on individual characteristics: age, sex, physiological condition, professional activity, physical activity, environmental conditions etc. [15].

The research was carried out, in the first phase, based on the analysis of the nutritional and energetic value of the menu. The next phase consisted of conducting an opinion poll based on a questionnaire, which aimed to establish and analyze the adolescents' food preferences.

Nutritional value of the menus was analyzed taking into study a week with 5 working days, the same menus for boys and girls. Both the nutritional composition and the energy value of these menus were calculated, then it was compared with the values imposed by the Order of the Ministry of Health no. 1563/2008 [16], which regulates the need for each group of adolescent. (Table 1).

Nutritional needs of adolescents are conditioned by age, sex and type of activity. The basic activity is school learning, a technological high school, the type of activity is the moderate one for this category of students. The energy requirement for boys (students) is 3100-3600 kcal / day, and for girls (students) 2500-2800 kcal / day [16]. As the canteen serves the boys and girls every day, the analysis of the daily menu was done for the daily energy requirement of 3100 kcal / day.

Foods are characterized by three traits: nutritional value, energy value and biological value. Nutritional value includes energy value, nutrient content, degree of assimilation and the ratio between sensory qualities and nutrients. The energy value is the amount of energy that food gives by oxidizing carbohydrates, lipids and proteins in the body. The biological value is represented by the quality of proteins in food, the composition of amino acids and digestibility. The way in which different foods contribute to the provision of nutritional needs depends on their nutritional characteristics, their content in nutrients, their qualities, the relationship between them.

Taking into account that the rational distribution of daily caloric needs is 25% for breakfast, 50% for lunch and 25% for dinner, the design will be made for this daily caloric requirement. The comparative analysis finds the deficiency or surplus of nutrients in food, as well as the amount of energy supplied.

The calculation of the nutrient intake and the energy value of the menu was performed using the nutritional tables from the literature [17].

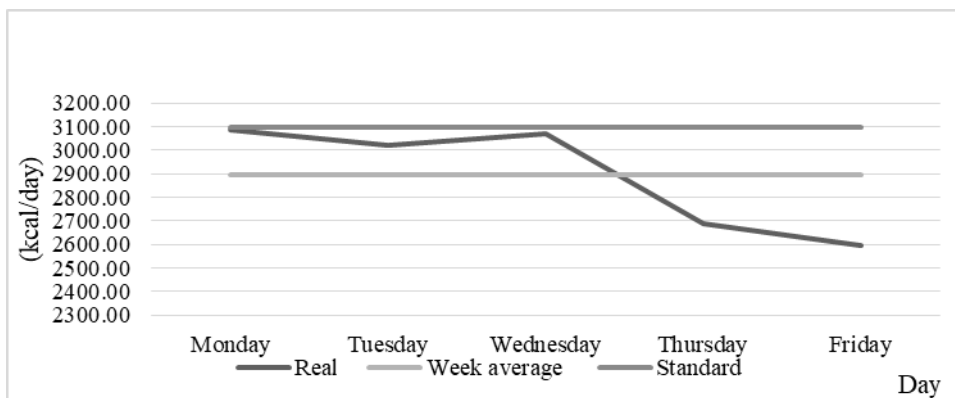
Depending on the menu for the days of the week (Monday to Friday) we analyzed the energy value and the amounts of nutrients provided daily. (Table 2).

**Table 1.** Energy level and nutritional structure of the diet for adolescents (g) [16]

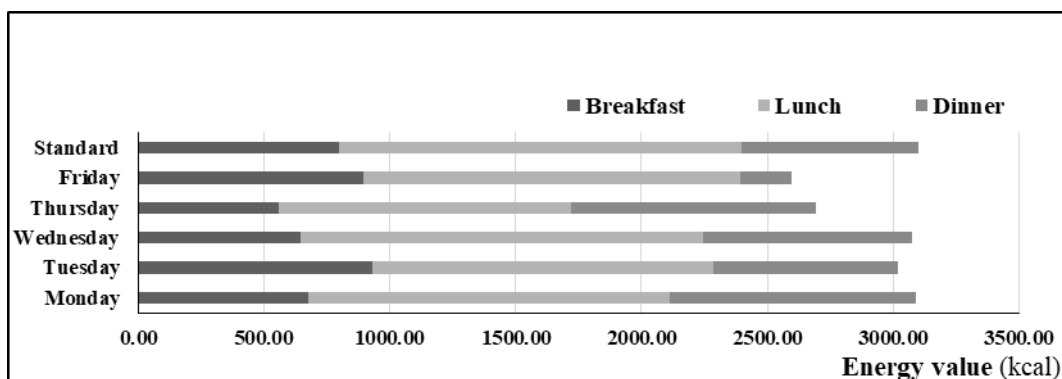
Adolescent category	Energy value (kcal / day)	Proteins (g)			Lipids (g)			Carbohydrates (g)
		Total	Animal proteins	Vegetal proteins	Total	Animal proteins	Vegetal proteins	
Boys 15-19 years	3100	120-137	60-69	60-69	94-113	60-79	28-47	470-521
Girls 15-19 years	2500	96-109	48-54	48-54	75-90	53-63	22-27	376-410

**Table 2.** Distribution of nutrients and energy values per days and the three meals server at the high-school canteen

Day	meals	Proteins (g)	Lipids (g)	Carbohydrates (g)	Energy value (kcal)
Monday	breakfast	27,27	30,2	81,35	677,6
	lunch	61,48	49,6	157,51	1432,8
	dinner	31,82	52,97	87,39	977,16
	<b>Total</b>	<b>120,57</b>	<b>132,77</b>	<b>326,25</b>	<b>3087,56</b>
Tuesday	breakfast	28,33	28,2	44,32	929,54
	lunch	97,44	106,5	116,65	1354,03
	dinner	37,52	3,26	91,26	736,66
	<b>Total</b>	<b>163,29</b>	<b>137,96</b>	<b>252,23</b>	<b>3020,23</b>
Wednesday	breakfast	23,53	14,6	32,59	647,0
	lunch	65,98	65,12	174,54	1595,94
	dinner	17,78	24,76	134,66	829,24
	<b>Total</b>	<b>107,29</b>	<b>104,48</b>	<b>341,79</b>	<b>3072,18</b>
Thursday	breakfast	28,33	28,2	44,32	560,0
	lunch	115,8	308,67	239,14	1157,46
	dinner	28,06	41,16	119,65	973,84
	<b>Total</b>	<b>171,19</b>	<b>378,03</b>	<b>403,11</b>	<b>2692,3</b>
Friday	breakfast	25,88	31,3	53,69	896,58
	lunch	63,15	65,27	153,76	1495,37
	dinner	12,7	8,0	37,4	205,82
	<b>Total</b>	<b>101,73</b>	<b>104,57</b>	<b>244,85</b>	<b>2597,77</b>



**Figure 1.** The energy value intake variation in a week compared to average and standard



**Figure 2.** Quantity of energy value intake in a week compared to standard

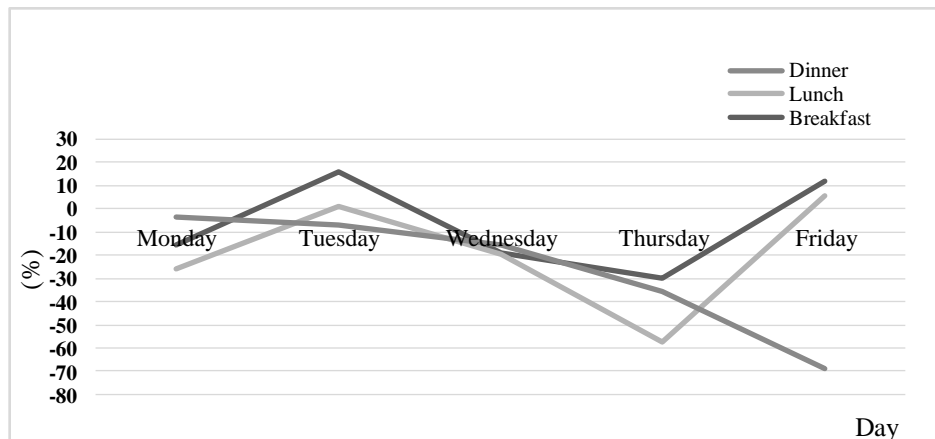


Figure 3. Variation of energy value intake depending on meals daily served (kcal)

The analysis of the data presented in Tables 2 reveals that the menu for Mondays, Tuesdays and Wednesdays approaches an appropriate menu in terms of daily food ration. The menu on Thursday and Friday is well below the required caloric intake per day. The weekly average energy value of the menu is 2893.81 kcal / day, a value that covers the energy needs of girls, but for boys it is insufficient. The weekly average energy value is different from the standard, small with 206.19 kcal, that means 6.65%. (Fig.1)

The analysis regarding the value of energy coverage on the three meals served everyday leads to the conclusion that in the 5 days the standard is not well respected.

Data showed that at the breakfast are positive deviations on Tuesday and Friday, of 16.19% and 12.07%. In the other days there are big negative deviations, between -15.30% for Monday and -19.13% for Wednesday, respectively -30% for Thursday (Fig.3). Being the most important meal of the day for the students, it is believed that the menu for breakfast for all days will definitely need to be revised and considerably improved. For lunch there are slightly smaller deviations, all negative, between -0.25—27.60%, which requires a more careful reanalysis and reconfiguration of this type of menu. Dinner deviations are even more important, with positive variations ranging from 3.66-22.15% for three days. The negative variations are much higher, -7.92% for Tuesday and -74.27% for Friday.

The average weekly protein consumption of 128.5 g provided in the norm for boys, in this age group, was exceeded, on average, by 4.31 g / week (Fig.4). The total amount of protein consumed is an average

deviation on this week of 3.36% from the norm. There is a big imbalance in the composition of the menus, a big difference between the 5 days of the analyzed week. Thus, on Tuesday and Thursday the amount of protein on the menu is much higher than the standard one. There is an overrun by 27.07% on Tuesday and an overrun by 33.22% on Thursday. On the other days, the amount of protein is quite below the standard, on Wednesday with 16.51% and on Friday with 20.83%.

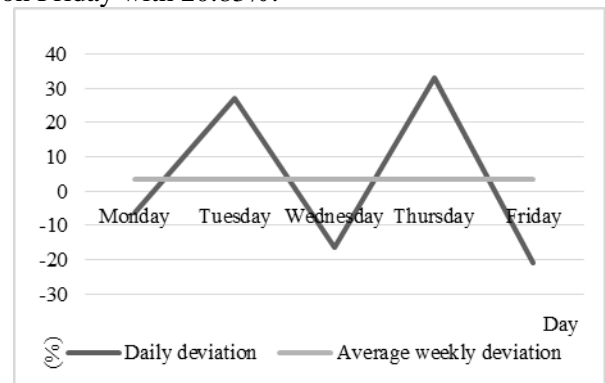


Figure 4. Daily deviation of protein intake compares to standard for boys

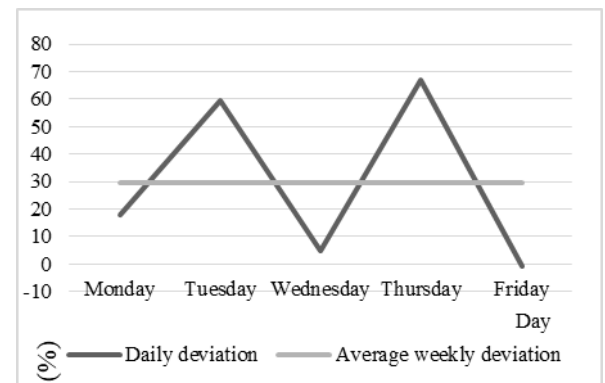


Figure 5. Daily deviation of protein intake compares to standard for girls

For the girls the average weekly protein consumption of 102.5 g provided in the norm in this age group was exceeded more than at the boys, by 30.31 g / week (Fig.5). The total amount of protein consumed is an average deviation of 29.57% from the norm. The menus of the girls were imbalance too, in the composition of the menus there were a big difference between the 5 days of the week. On Tuesday and Thursday, the amount of protein on the menu is much higher than the standard one.

There is an overrun by 59.31% on Tuesday and an overrun by 67.01% on Thursday. On the other days, the amount of protein was higher, but not so much than the norm, on Monday with 17.63% and on Thursday with 4.67%. Only Friday the content was under the norm, with 0.75%. The normal lipid consumption for students in the age category 15-19 years, boys, is 103.5 g / day. Analyzing the data for the 5 days we find that consumption was usually exceeded, so on Monday and Tuesday by 29.27 g, respectively by 34.46 g, then on Thursday by 274.53 g.

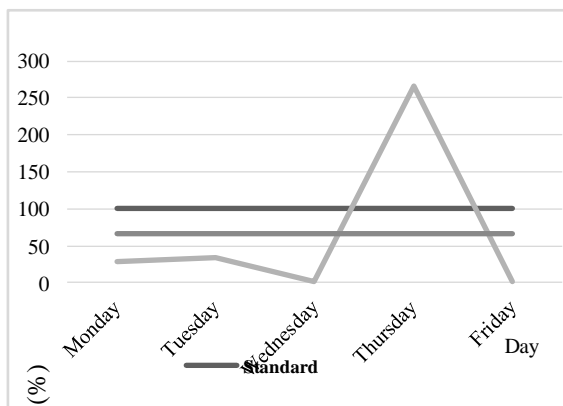


Figure 6. Daily deviation of lipids intake compares to standard for boys

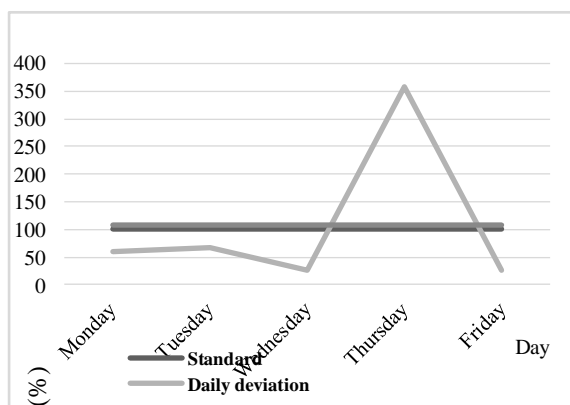


Figure 7. Daily deviation of lipids intake compares to standard for girls

For the whole week the excess was 71.56 g, representing 65.76% compared to standard (Fig. 6). For girls these data are even higher, because the standard amount is 82.5 g / day. There was a weekly exceedance of 107.95% compared to the norm. (Fig.7)

Carbohydrates content is 495.5 g for boys and 393 g for girls, daily. Is higher on Tuesdays, compared to the other menus on Mondays, Wednesdays, Thursdays and Fridays, but the weekly carbohydrate intake is a bit deficient. (Fig.8) The week average carbohydrate deficit is 36.70% for boys and 20.19% for girls for the norm. (Fig.9)

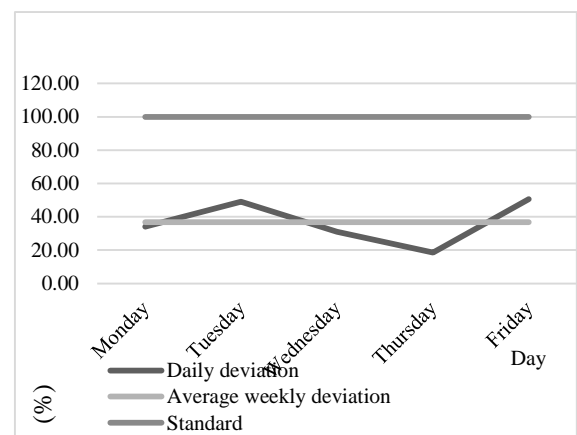


Figure 8. Daily deviation of carbohydrates intake compares to standard for boys

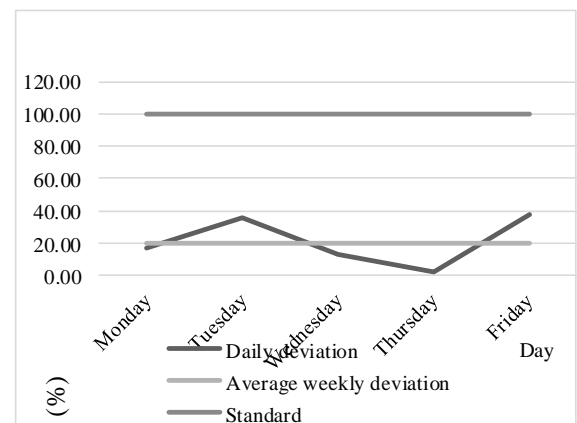


Figure 9. Daily deviation of carbohydrates intake compares to standard for girls

In order to optimize the carbohydrate content, some dishes from the Tuesday menu must be replaced, the carbohydrate intake being extremely high. For example, honey can be taken out of breakfast and dessert for breakfast (donuts) could be replaced with

fruit. In the end of this part it can say that the analysis of the menus for the 5 days demonstrates a general framing in the standard, with different deviations of the nutrient content. (Fig. 10)

The second part of the study consisted of the answers to a questionnaire on the food preferences and daily habits of the participants. The age structure of the participants is presented in Fig. 11.

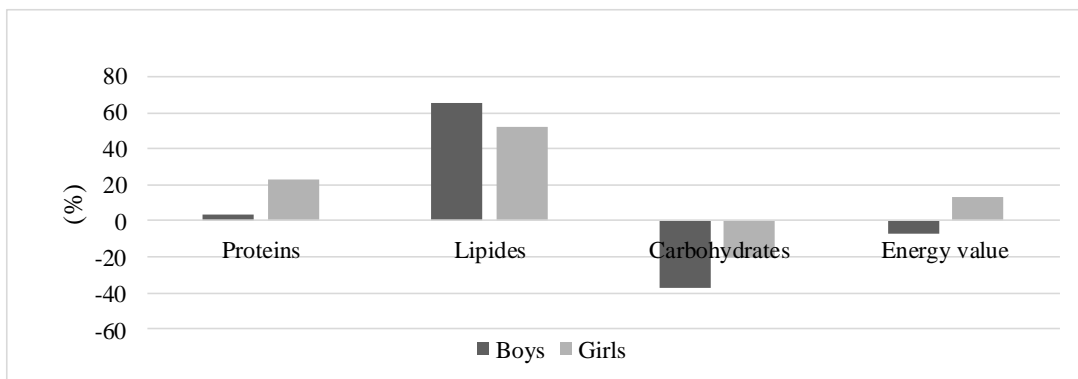


Figure 10. Global characterization of the nutritional content of the menus (%)

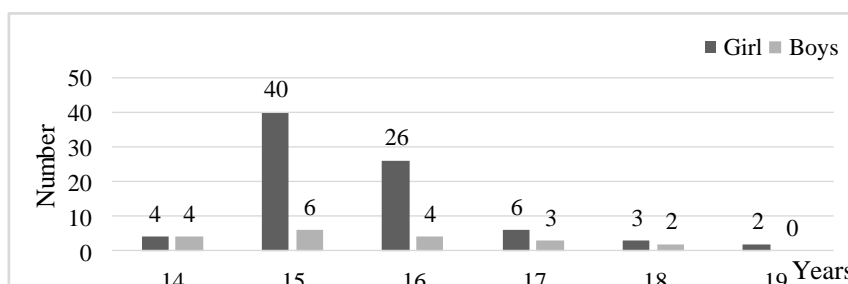


Figure 11. Structure of the age of participants

The health of adolescents is an important issue in the context of the analysis of the food style practiced because it illustrates the effect of the type of diet they have. At the question “Do you suffer from any medical problem in adolescence?”, their answers were centralized in Table 3.

Table 3. Medical problems

Answers		Medical problems
Yes	26	Asthma, anemia, hormonal disorders, psoriasis, acne, fatty liver, gastroesophageal reflux, ragweed allergy, insomnia, food allergies
No	74	There are no medical problems

From the analysis of the answers obtained, it is found that the vast majority of students do not have medical problems (76 %). 26% of them stated that having different medical conditions, either induced by the way they eat (fatty liver, gastroesophageal reflux) or influenced by poor diet (anemia, food allergies, psoriasis, asthma), others are characteristic of age (hormonal disorders, insomnia, acne).

In adolescence, eating habits change for the worse, the rhythm of meals becomes irregular, many snacks (pre-packaged and high-calorie) are consumed, and food choices are chaotic, with no nutritional interest.

When the students were asked about the number of meals served daily (Fig. 12), the students surveyed have a predominantly healthy diet, more than half of them serving 2 meals a day: 21% serving 2 meals a day, 44% serving 3 meals a day. If we take into account the fact that together with snacks, we have 5 meals a day, we can see that only 12% of students have a healthy diet, while 5% of students eat only once a day.

To the question “What meal do you consider as the main meal of the day”, they answered breakfast. (Fig.13) The graph shows that students attach special importance to breakfast (62%), while only 25% have lunch and 12% also serve dinner (Fig.13).

In fact, most of them serve lunch, that shows they are aware that it brings 50% of the energy needs of the daily diet, being a healthy eating habit.

It is a fairly healthy eating habit, especially since it represents about 50% of the food consumed in a day.

The consumption of chips is insignificant for the surveyed group.

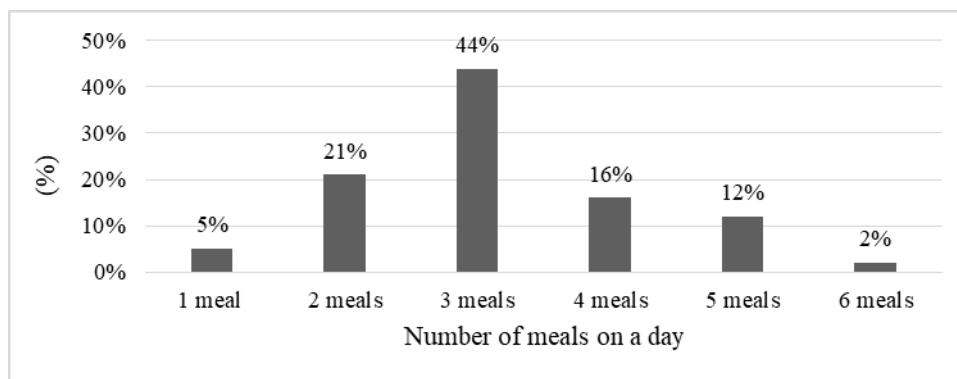


Figure 12. Food rhythm of the investigated community

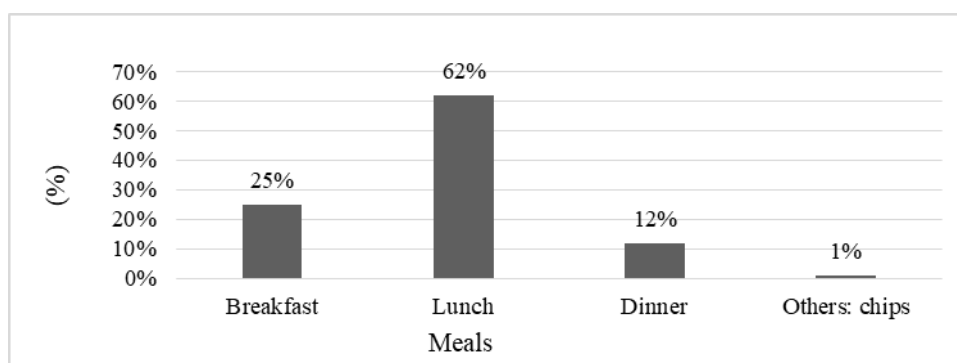


Figure 13. Favorite meal of the day

Students prefer freshly cooked food at home (85 - 89%) and only 7% choose food at the restaurant or ordered. This may also be related to the material condition of the students or the impossibility of preparing food (institutionalized students who are not satisfied with the meal in the canteen).

The diet of adolescents should be varied, complex, very rich and different from that of adults, and diets not medically indicated, either focused on vegetables or exclusively with meat will be prohibited, as harmful (Table 4).

Table 4. Eating habits of the investigated community

Variant	Answers		
	Yes	Sometimes	No
I eat a healthy breakfast	30	52	18
I often get appetite during the day	41	45	14
I eat meat	82	18	0
I eat vegetables	71	27	2
I eat fruit	70	28	2
I eat dairy products	71	26	3
I eat sweets	75	23	2
I eat food prepared without meat	46	43	11
I have unhealthy eating habits	42	48	10

From the Table 4 it is observed that 30% of students eat breakfast daily, most (52%) sometimes serve. Students consume in quite high percentages (70 - 82%) food with meat, vegetables, fruits, dairy products and food without meat. 75% of students prefer to eat sweets - there is a high consumption of sweets, this being known as excess sugar always creates an addiction. 48% of students admit that they have unhealthy eating habits and also and 45% of students eat without respecting the main meals. Regarding the frequency of consumption of various foods and beverages by students, there were many types of responses. (Tab.5)

From the analysis of Table 5 it can be observed that students: eat cakes or sweets daily, eat more vegetables in salads than fruits in snacks, prefers to consume milk and dairy products and only 30% consume 1.5 l of plain water daily. Also, several times a week, students consume fast food products, meat products, liquid dishes (with and without meat), basic dishes with fried or fried meat and rarely chocolate, chips and sour juices, which shows that they have habits. healthy eating.

Consumption of meat, a food that is the main source of animal protein, is high enough. 34 % students have a diet in which meat and meat products represent 50%. It should be noted that not daily is the highest consumption, but weekly, when a significant increase in the percentage is observed. There are also students who do not consume this food at all and should compensate for the need for protein from other sources.

**Table 5.** Comparative analysis of the frequency of food consumption

Food	Once a day	Several times / week	Rare
Cakes, sweets	28	16	11
Chocolate	16	32	35
Fast food products	5	72	17
Furnace products	8	71	9
Fresh fruit for snacks	29	22	22
Fresh vegetables, salads	33	31	17
Chips, snacks, puffs - with taste	12	20	43
Tasteless chips / puffs, simple snacks	12	25	40
Cooked meat dishes	25	35	29
Fried meat dishes	23	43	25
Grilled meat dishes	12	36	48
Sausages, meat by-products	23	38	27
Fries	19	35	39
Soups, vegetable soups	31	41	17
Soups, meat soups	25	44	21
Milk, dairy products	34	32	17
Flat water (min 1.5 l)	30	9	6
Sour juices (min 250 ml)	13	16	37
Natural juices, fresh, fruit / vegetable shakes	18	23	38

#### 4. Conclusion

Students from the national college where the study was conducted, are generally aware of the importance of nutrition on maintaining good health. An important part of them focus on the meals served and their nutritional value. It is important to emphasize the importance of consuming fresh fruit and vegetables, low-fat milk and dairy products, lean meat and fish, and to reduce the consumption of carbonated soft drinks and dairy products, fast food type that negatively influences the health of consumers. Some of the adolescents in the research group, probably motivated by the desire to lose weight, reduce the number of meals consumed daily, this unhealthy practice can lead over time to the permanent habit of serving one meal a day.

This eating behavior is associated with the risk of various nutritional diseases. Education is another factor that influences healthy eating and plays an important role in establishing appropriate eating behavior. The role of education results from the fact that students have several notions on this topic, in the conducting classes being debated the topics of interest of age. In conclusion, a teenager or a high school student needs vitamin, water, daily carbohydrate intake, etc. according to age, sex, daily school activity, competitions, including daily sports or performance sports.

**Compliance with Ethics Requirements.** Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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