PREVALENCE OF OVERWEIGHT AMONG STUDENTS AS A DETERMINING FACTOR OF INTERVENTION THROUGH PHYSICAL EXERCISES

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Abstract

Child and adolescent health is a current issue. In the last three decades, the prevalence of overweight and obesity has soared both among the adult population and especially among children around the world, one of the causes being a sedentary lifestyle. In order to fight against it, specialists in the field of physical education and sports have the task of designing effective strategies to make young people aware of the need to spend their leisure time actively through physical activities.

Through this study we wanted to find out the prevalence of overweight among adolescents aged 14 to 16, taking into account a sample of 663 subjects, namely students from 6 schools in 5 different counties. After calculating the body mass index, separately for boys and girls, we found that the recorded means fell within the normal weight range. Numerically, however, 18% of female subjects did not fall within the accepted normal weight range, 3% being below the normal weight limit and 15% slightly above the threshold. In the case of boys, 17% were not at a normal weight, 5% being underweight and 12% overweight.

In conclusion, although the body mass index mean showed that the chosen sample was placed within the limits of the normal weight threshold, the mean percentage of 13.5% of the number of cases that fell within the overweight range is a worrying one, which requires clearly defined actions characterized by complex directions of intervention plans.

Key words: overweight, somatometric indicators, physical activity, physical education and sport, adolescents.

Introduction

As part of the quality of life, population health depends on both the biological potential of the individual and the level of his/her motor capacity. Child and adolescent health is a topical issue, which determines the need to understand the impact of environmental factors related to physical activity in order to design effective strategies to combat sedentarism and to reduce its negative impact on life expectancy or work capacity. Adolescence is one of the most important periods in a person's life (De Kankana, 2017).

Adolescence is characterized by various biological, social, and behavioral changes that significantly affect health habits, including social, family, and cultural habits (Moreira et al., 2015).

According to the World Health Organization (WHO), adolescence is the life stage between childhood and adulthood which is characterized by a complex process of biological and psychosocial growth and development that takes place between ages 10 and 19, overlapping with the onset of puberty (Jaworska, MacQueen, 2015). During this period, a sudden acceleration of growth and physical development takes place. From a physical point of view, the changes include a rapid increase in height and weight, the development of secondary sexual characteristics and changes in the amount and distribution of muscle and fat mass (Özdemir et al., 2016). These changes in body composition along with changes in food intake or

physical activity, as well as a sedentary lifestyle, have led to an increased risk of overweight/obesity among adolescents (Alberga et al., 2012). The prevalence of overweight and obesity in the last three decades has risen to alarming levels in both the adult population and, especially, in children around the world, being considered a serious threat to public health (World Health Organization, 2018). Obesity prevention should include policies and preventive measures against child obesity, especially since weight loss has proven to be extremely difficult (Faienza et al., 2016; Golomb et al., 2015; Dombrowski et al., 2014). WHO describes overweight and obesity as an abnormal or excessive accumulation of fat in the body adipose tissue, which can affect the health of children, adolescents, young people and adults (López-Sánchez et al., 2019; Tiwari et al., 2014; Daştan et al., 2014). Hippocrates stated that: "Corpulence is not only a disease itself, but the harbinger of others" (Hong et al., 2016; Revenco, Dolapciu, 2014). Obesity is on the rise worldwide, affecting children and adults in developed countries, but a percentage increase can also be noticed in developing countries (Pattinson et al., 2017; Biswas et al., 2017; Ng M, Fleming T, Robinson M, et al., 2014).

Overweight and obesity are ranked fifth as a risk factor for death in the world, being referred to as the pandemic of the 21st century. Excess weight was reported in boys following a study in several European countries, such as Slovenia, Spain, Italy, Greece or Hungary (Brug et al., 2012). Obesity has reached

alarming levels in the European Union, including Romania, where there is a percentage of 20-25% of cases compared to the number of people (Gallus et al., 2015; Roman et al., 2019; Dorobanțu et al., 2008). In 2013, the World Health Organization (WHO) reported an overweight prevalence of 26.8% (11.6% for obesity) in 8-year-old children in Romania, using WHO reference (Nicolescu, 2013), which was among the highest percentages reported in international COSI samples (Wijnhoven et al., 2014).

In Romania, several studies focused on different groups to measure the weight of children and adolescents (Inchley et al., 2020; Chiriță-Emandi et al., 2016; Barbu et al., 2015). One of the studies indicated that 16.8% of boys, and 16.3% of girls were overweight, of which 7.8% of boys and 6.4% of girls were classified as obese (Mocanu, 2013). Chiriță-Emandi et al., (2016) indicate in their study that a significant part of the children in Romania are either underweight or overweight. Boys were 1.4 times more likely to be overweight compared to girls. The COSI study, data collection round in Romania in 2013, also showed that 8-year-old boys had a higher overweight and obesity prevalence (29.8%) compared to girls (23.7%) (Nicolescu, 2013).

In 2017/18, the health behavior of Romanian children aged 11, 13 and 15 was studied and the overweight, obesity and underweight were investigated. The results showed that among girls, overweight (including obesity) was 22% (for 11-year-old children), 15% (for both 13-year-old and 15-year-

old children), while among boys, the results were 32%, 30% and 27%, respectively, for the three age groups. Underweight ranged from 4-6%, both among girls and boys of different ages. The percentage of girls who considered they were overweight ranged from 24% among 11-year-old children to 34% among 15-year-old children, while in the case of boys the percentage was 25% among 11-year-old children, 24% among 13-year-old children and 21% among 15-year-old children (Inchley et al., 2020). The percentage of overweight children in Romania has changed dramatically in children of different ages, the highest percentages (34% on average) have been recorded in children aged 6 to 12, while it has decreased to less than a half in children aged 15 to 19, the logistic regression indicating a 3.9-fold predisposition of the first age category.

The variation was maintained after stratification according to sex, although with lower values for girls compared to boys. Moreover, other studies found higher prevalence in pre- and early adolescence (Kowal et al., 2016; Whitaker et al., 1997). Weight gain before puberty involves the earlier initiation of the maturation process, being mediated by the concentrations of luteinizing hormone in girls (Addo et al., 2014). Therefore, there is an urgent need for early interventions in the pre-adolescent years, in both sexes, in the case of Romanian children.

Therefore, there is an urgent need for early interventions in the pre-adolescent years, for both sexes, in Romanian children.

Materials and methods

This study was conducted between September 21, 2020 - October 9, 2020, on a sample of 663 students in grades 9-10 (367 girls and 296 boys), in 6 randomly chosen Romanian schools (Dolj, Satu Mare, Botoșani

and Gorj), aged 14-16 (Table 1), who were available to take part in the study. The adolescents receiving nutritional counseling, those with special educational needs and disabilities were not subject to the study.

Table1. Number of students selected by school and grade

SCHOOL	9TH GRADE	10TH GRADE
"Carol I" National College, Craiova	65	63
"Frații Buzești" National College, Craiova	55	53
"Marin Sorescu" High School of the Arts, Craiova	55	57
"Ioan Slavici" National College, Satu Mare	51	49
"Tudor Vladimirescu" National College, Târgu-Jiu	55	57
"A.T. Laurian" National College, Botoșani	52	51
TOTAL	333	330
TOTAL	663	

The data were recorded after receiving the consent of the subjects and that of their parents, according to the Declaration of Helsinki.

Anthropometry is of particular importance during adolescence, as it provides long-term health indicators in children and adolescents to describe growth patterns, trends in body growth and development over time, disease risks, nutritional and general health, being a crucial tool for the diagnosis of obesity (Sousa, 2017).

Body mass index (BMI) [body weight (kg) / height (m)^2] is the most common tool used by the World Health Organization as a standard for recording obesity and constructing growth curves in children and adolescents (Keys et al., 2014; Pekar, 2011; de Onis et al., 2007).

Weight, expressed in kilograms and measured using the medical scales in the medical offices of the schools.

Height, expressed in centimeters (the program will convert it to meters) and measured using the thalliometers or the measuring tape in the medical offices of the schools.

The anthropometric variables selected for the analysis were body weight and height. We considered that the two somatometric variables were sufficient to determine the physical development of students both directly and by calculating the body mass index in order to assign them to harmonic or disharmonic, hypo- or hyperweight and/or statural classes. The measurements (height and weight) were made according to the WHO recommendations, students wearing few clothing items and no shoes, and each evaluation was considered as an average of three consecutive measurements. Weight was measured in kg with electronic scales, and the height (cm) was measured to the nearest 0.1 cm, using a thaliometer, namely the standard equipment of the medical offices in the schools. Height and body weight were obtained using calibrated scales. After measuring height and weight, we calculated the body mass index for age. A BMI-z score was also calculated. The ANOVA test was applied to determine the significance of the difference between the BMI values recorded by the subjects, by sex (male and female). To highlight the normal weight, we used the BMI percentile calculation, a function that shows the tendency to overweight in children under evaluation. The exact ages were classified into age groups x. The anthropometric measurements were performed in the morning, before lunch time. The adolescents were asked to go to the toilet just before the measurements.

The Somatometric Calculator is a program in Excel 2007 that manages somatometric data (height and weight) of children in kindergartens and students in elementary, middle and high schools. It includes

statistical data represented by the growth charts developed by CDC (Centers for Disease Control and Prevention, 2009, Olteanu, E.T., 2018) and mathematical formulas, necessary for the BMI calculation, BMI percentiles, height percentiles and their interpretation.

WHO reference values in 2007 for age and sex in children aged 5-19 classifies children's BMI using standard deviations (SD) as follows: overweight:> 1 SD (equivalent to BMI 25 kg / m2 at age 19); obese:> 2 SD (BMI equivalent 30 kg / m2 at age 19); severely obese:> 3 SD; thin: <-2 SD; severely thin: <-3 SD (de Onis et al., 2007; World Health Organization, 2007). In the case of children, the interpretation of BMI is very difficult because of the rapid growth and development of the body. In order to compare the BMI value with the standard one, it is recommended to take into account the z score, the BMI standard deviation (zstd), age and sex (de Onis et al., 2009; Güngör, 2014). BMI is a good indicator of the variability of energy reserves in individuals having a sedentary lifestyle, but not in athletes [70,72 for children and adolescents, the BMI ratio is made to the percentile curves, and the dynamic change of BMI is expressed during growth (Caflish, Morel-Gotzos, 2007). Age and gender percentile curves of the BMI ratio remain the most common method for children and adolescents as overcompensation and detection, as screening for overweight and for detecting the risk of obesity or underweight (Rajka, 2018; Sagar & Gupta, 2018).

Overweight and obesity were determined using BMI based on age- and sex-specific cut-off points proposed by Cole et al. (2007). BMI categories of 25.0-29.9 (overweight) and 30.0 or more (obese) (World Health Organization child growth standards, 2006; Cole et al., 2000).

Results

The statistical analysis was performed using Excel 2019. The sex differences as regards anthropometric characteristics were analyzed by one-way analysis of variance (ANOVA). Correlation coefficients were calculated to measure the statistical dependence between anthropometric indices and age. The choice of schools where the adolescents were selected was made using the so-called drawing function without repetition of Statistica software. Prevalence ratios were calculated with a 95% confidence interval. In order to implement

the program, it is necessary to use international statistics provided for users on the World Health Organization website or on the CDC website (Centers of Disease Control and Prevention, 2009). The measurable data were characterized using the mean and standard deviation. The Somatometric calculator was designed using the data necessary to carry out such a program, made available to users on the previously mentioned website. The results are given as numbers and tables.

Table 3. The mean level of physical development in boys aged 14-16

Age (years old)	Height (cm)		Weight (kg)	
	Xp	τ	Xp	τ
14	174	5,93	64,85	11,16
15	175	7,13	65,01	10,99
16	174,5	8,09	65,75	11,36

Table 2. The mean level of physical development in girls aged 14-16

Age	Height (cm)		Weight (kg)	
(years old)	Xp	τ	Xp	τ
14	168,86	7,70	58,41	7,47
15	165,90	6,40	55,86	7,84
16	165,32	5,70	56,47	6,44

The mean level of development in boys as regards height is lower for the age of 14 and higher for the age of 16, in girls it is lower for the age of 16, but it is higher for the age of 15. The mean level of weight for boys is lower for the age of 15 and higher for the age of 14, whereas in girls it is lower for the age of 16 and higher for the age of 15. We thus notice that boys are much taller and heavier than girls.
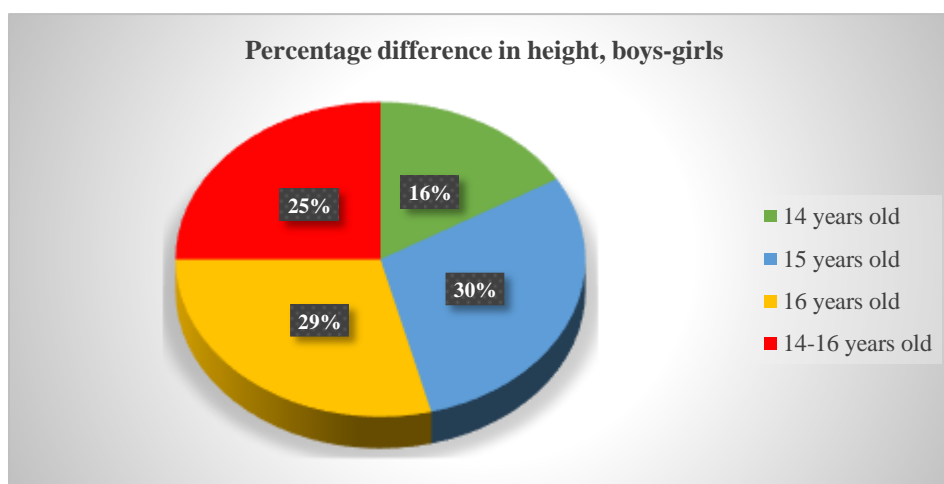

Diagram 1. Percentage differences in height means by age, boys-girls
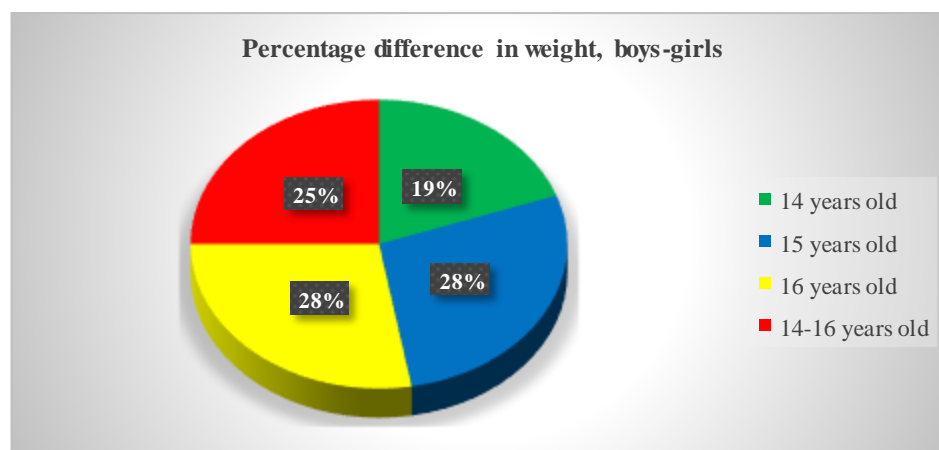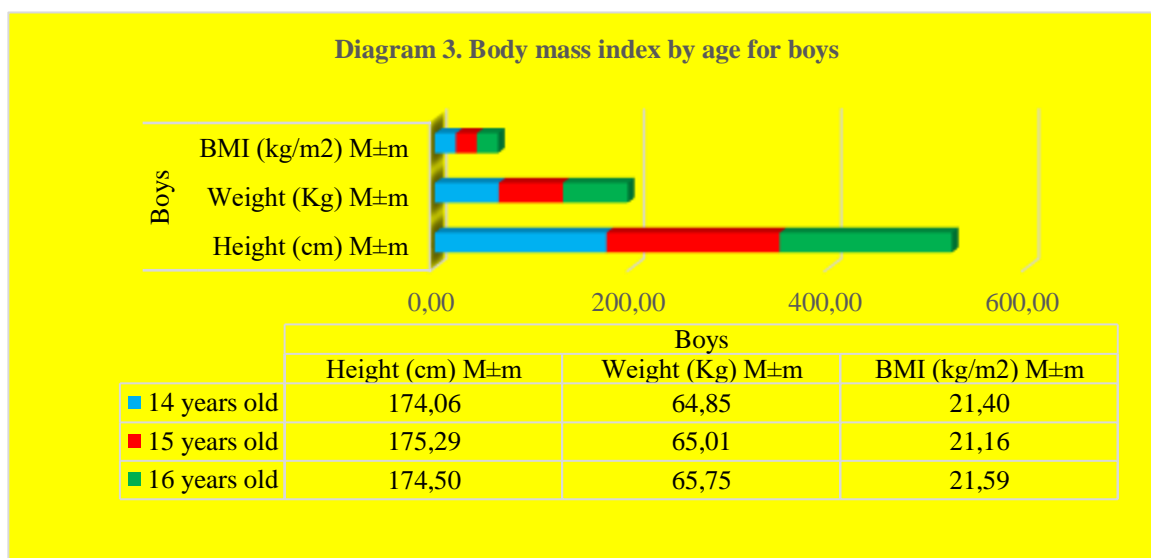

Diagram 2. Percentage differences in weight means by age, boys-girls

Important information on the BMI values was obtained from calculating the percentiles, which illustrates the frequency of cases of normal weight.

Table 5. Body mass index by sex and age

Indices/	Boys		
Age	Height (cm)	Weight (kg)	BMI (kg/m2)
14 years old	174,06	64,85	21,40
15 years old	175,29	65,01	21,16

16 years old	174,50	65,75	21,59
Indices/ Age	Girls		
	Height (cm)	Weight (kg)	BMI (kg/m2)
14 years old	168,86	58,41	20,48
15 years old	165,90	55,86	20,30
16 years old	165,32	56,47	20,66

Diagram 3. Body mass index by age for boys

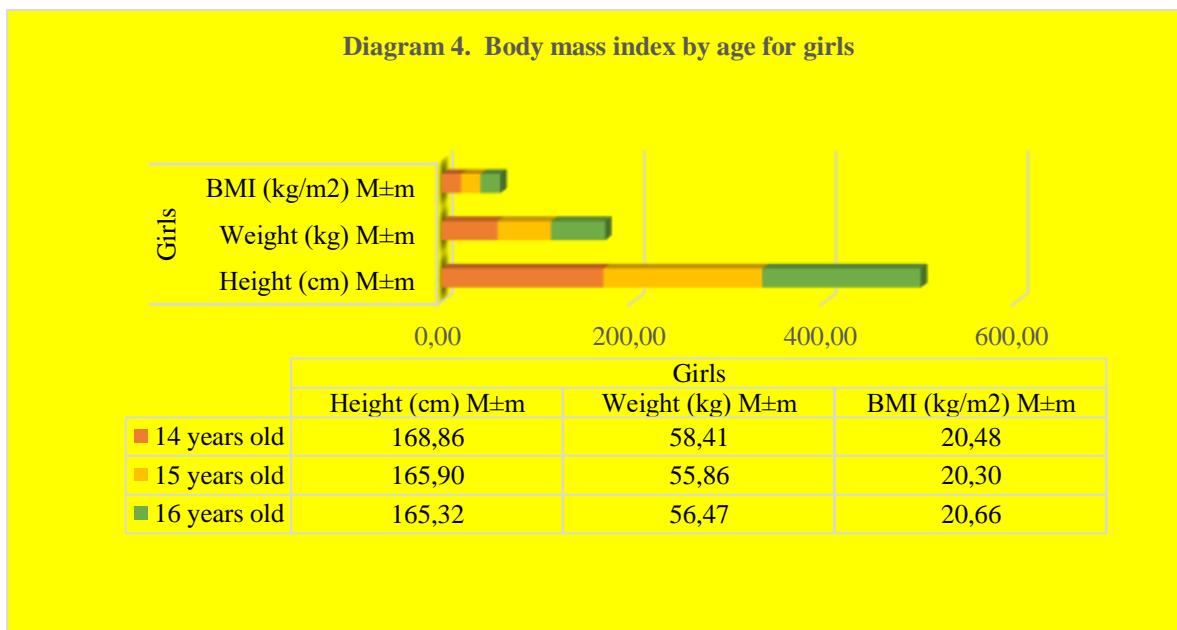| | Boys | | |
	Height (cm) M±m	Weight (Kg) M±m	BMI (kg/m2) M±m
■ 14 years old	174,06	64,85	21,40
■ 15 years old	175,29	65,01	21,16
■ 16 years old	174,50	65,75	21,59

The BMI mean of the subjects included in the study in both girls and boys falls within the mean values of the ranges accepted for normality at these age levels, but we can observe that this value is influenced by those who obtain values placed towards the minimum value of these ranges.

In this regard we mention: for 14-year-old girls the accepted weight range is between 48 and 69kg (mean 58kg) and the BMI range is between 19.4 and 23.2 (mean 20.3);

- for 15-year-old girls the accepted weight range is between 45-68kg (mean 56kg) and the BMI range is between 20.2-23.2 (mean 20.3); for 16-year-old girls the recommended weight range is between 48 and 68kg (mean 56) and the BMI range is 20.3-22.8;

- for 14-year-old boys the normal weight range is between 50-72 kg (mean 65 kg) and the BMI range is between 19.8-22.6 (mean 21.5); for 15-year-old boys the weight range is between 52-75kg (mean 65) and the BMI range is 20.2-23.1 (mean 21.2); for 16-year-old boys the accepted weight range is between 53-76kg (mean 66kg) and the BMI range is 21.0-23.7 (mean 21.8).

Diagram 4. Body mass index by age for girls

	Girls		
	Height (cm) M±m	Weight (kg) M±m	BMI (kg/m2) M±m
■ 14 years old	168,86	58,41	20,48
■ 15 years old	165,90	55,86	20,30
■ 16 years old	165,32	56,47	20,66

We performed a bivariate visualization of the data using Scatter Graphs - this analysis shows that only two pairs of variables reveal a weak correlation: BMI based on height and weight.

Diagram 5. BMI values by age, sex and grade
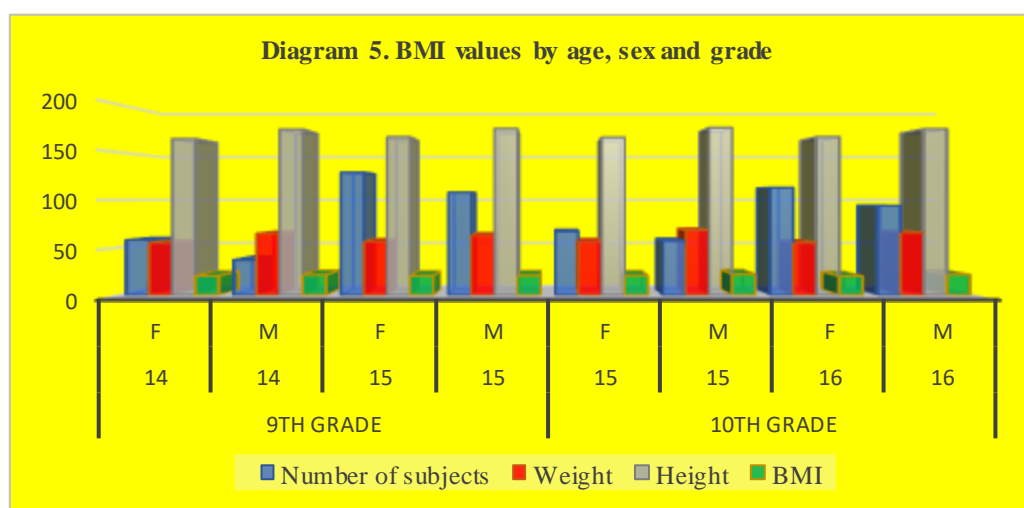
We observe that the results are situated in the mid-ranges accepted for normal weight in terms of both the means of body weight and the values of the body mass indices.

Although the mean results show a reassuring aspect as regards the percentage of subjects who do not fall within the normal weight range, the situation is no longer good as shown in table 5 which includes the values of the arithmetic mean (AM), the coefficient of variation (Cv) and of the percentiles, indicating the percentage of the normal weight population in the investigated sample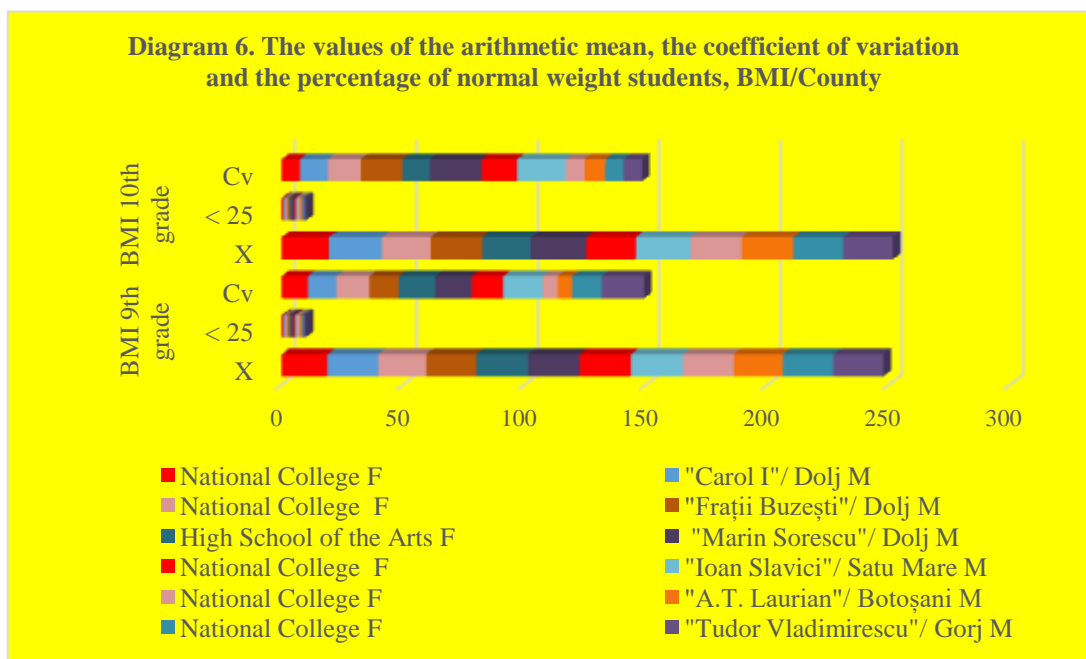. From the analysis of the results by grades, it seems that the BMI rounded values for girls are 20.52 (9th grade) and 20.31 (10th grade). For boys, the values are 20.78 (9th grade) and 21.64 (10th grade). Important information about the BMI value is obtained from calculating the percentiles, indicating the frequency of the case in the normal weight range.

The percentage of the BMI normal values in 9th grade girls is 82.07%, and in 10th grade girls is 81.23%.

The percentage of the BMI normal values in boys is 83.14% (9th grade) and 86.57% (10th grade).

Table 7. The values of the arithmetic mean, the coefficient of variation and
the percentage of normal weight students, BMI / County

HIGH SCHOOL/ COUNTY	SEX	BMI 9th grade			BMI 10th grade		
		X	< 25	Cv	X	< 25	Cv
"Carol I" National College/ Dolj	F	18,9	75,79%	10,8	19,5	78,23%	7,4
	M	20,8	83,29%	11,7	21,7	86,87%	11,5
"Frații Buzești" National College / Dolj	F	19,7	78,89%	13,5	20,1	80,63%	13,6
	M	20,6	82,56%	12,1	21,1	84,57%	17,0
"Marin Sorescu" High School of the Arts/ Dolj	F	21,3	85,30%	15,0	20,0	80,24%	11,2
	M	21,2	84,90%	14,9	22,8	91,40%	21,4
"Ioan Slavici" National College / Satu Mare	F	21,1	84,80%	13,0	20,3	81,47%	14,6
	M	21,3	85,27%	16,2	22,4	89,80%	19,9
"A.T. Laurian" National College / Botoșani	F	21,0	84,04%	6,2	21,1	84,77%	7,7
	M	20,1	80,52%	5,8	21,1	84,72%	8,5
"Tudor Vladimirescu" National College / Gorj	F	20,8	83,60%	12,24	20,5	82,08%	7,5
	M	20,5	82,32%	17,3	20,5	82,08%	7,5

Diagram 6. The values of the arithmetic mean, the coefficient of variation and the percentage of normal weight students, BMI/County

By making a general mean of the percentage of female subjects who do not fall within the range of normal weight, we obtain a value of 18% of which only 3% are underweight and the remaining 15% cross the threshold to overweight, a percentage that we can already consider high, taking into account that the schools represented by these subjects are elite schools in which health education is not neglected.

As regards the boys, 17% of them do not fall within the accepted range of normal weight, 5% of them being underweight and 12% overweight.

Therefore, the careful analysis of the data reveals the necessity of intervention measures.

Our recordings took into account the fact that in the 9th grade there are 14-year-old students but also 15-year-old ones, the situation being the same in the 10th grade where there are 15- and 16-year-old students. However, we made synthetic data for the education levels as well, starting from the idea that, for the most part, the group and the imposed school activities can in turn influence the adopted lifestyle.
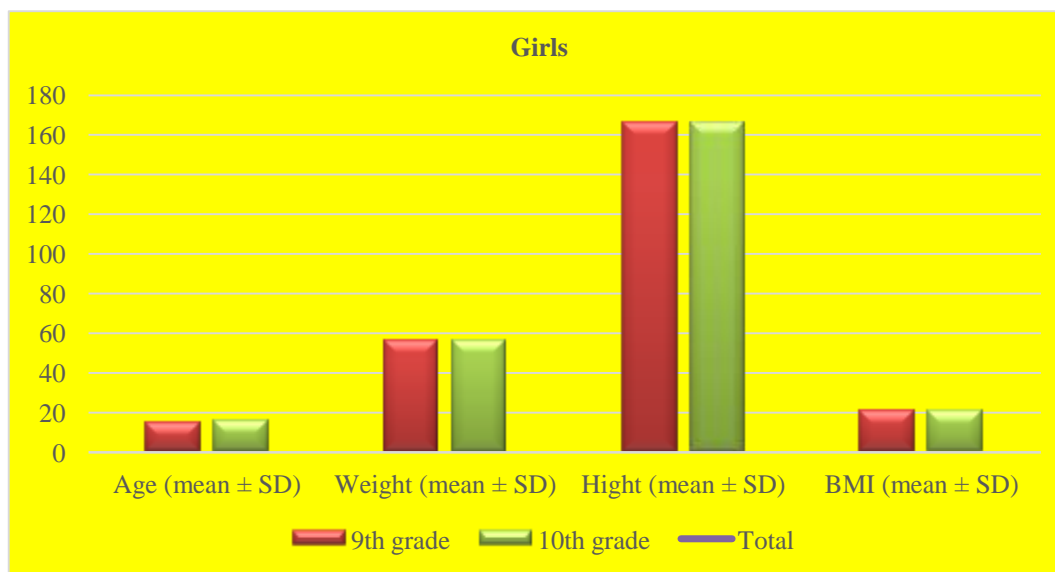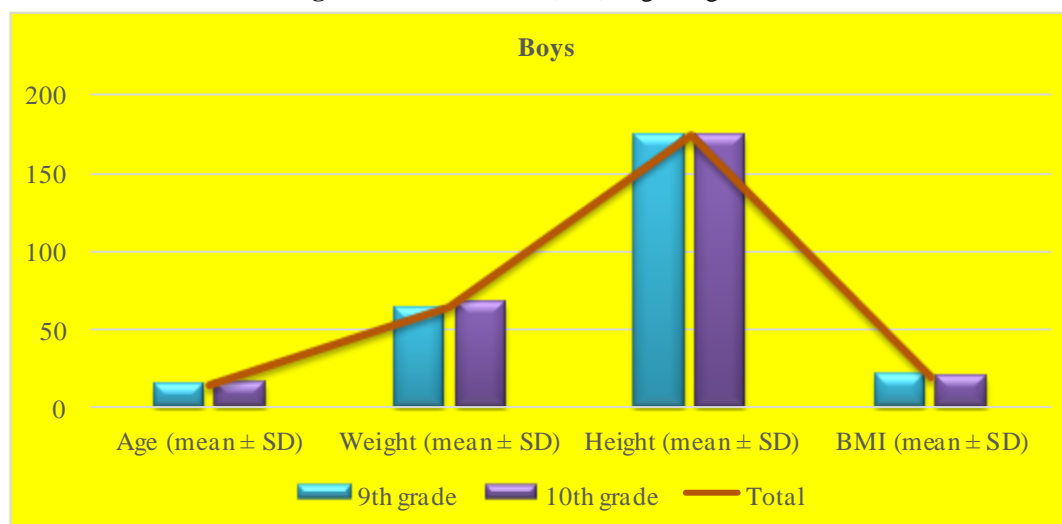
Diagram 7. Mean values (±SD) in girls aged 14-16.

Diagram 8. Mean values (±SD) in boys aged 14-16.

Table 6. The values of the arithmetic mean, standard deviation and the coefficient of variation of height

9th grade	Arithmetic Mean of Height	Standard Deviation of Height	Coefficient of Variation of Height
G	165,51	6,67	4,03
B	174,71	6,65	3,8
10th grade	Arithmetic Mean of Height	Standard Deviation of Height	Coefficient of Variation of Height
G	56,04	7,73	13,79
B	63,18	10,32	16,34

Table 7. The values of the arithmetic mean, standard deviation and the coefficient of variation of weight

9th grade	Arithmetic Mean of Weight	Standard Deviation of Weight	Coefficient of Variation of Weight
G	165,95	6,08	3,66
B	174,88	7,89	4,51
10th grade	Arithmetic Mean of Weight	Standard Deviation of Weight	Coefficient of Variation of Weight
G	55,84	6,92	12,39
B	66,95	11,81	17,64

The values of the standard deviation and the coefficient of variation indicate the lack of homogeneity of the investigated groups due to the level of chronological age to which we referred and where there are differences in biological age. At the same time, it is an age range for which ameliorating interventions can be successful.

Conclusions

Following the undertaken study we can state that:

- Adolescence is the stage in which, the success rate after the interventions focused on adopting a healthy lifestyle with a sufficient energy intake calculated so as to ensure a biological development without deficiencies but also with a significant amount of free time dedicated to physical exercise, the positive answers are supported by its specific psychosocial peculiarities.

- The actions meant to prevent excess body weight must be based on strategies having complex directions in terms of intervention plans.

- We did not consider the inclusion in the research of schools with very good learning results, taking into account that the students in such schools have sufficient information regarding the importance of acquiring and/or maintaining an optimal body weight. However, randomly, the schools that responded to our request are elite schools and we strongly believe that this influenced the means of results.

- Although the mean results place the subjects in the normal weight range, our study showed that a significant percentage of about 13.5% is represented by overweight students drawing near to the maximum allowed, namely to obesity, some of them falling right within this range. The envisaged perspective, considering the differences in the biological age, is that some of the normal weight students will move towards overweight.

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