

STUDY OF BODY COMPOSITION AND OBESITY IN CHILDREN AGED 12-14 YEARS

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Abstract: *In the last decades, the topic of physical activity and the consequences of lack of movement among adolescents have been particularly relevant. The purpose of the current study is to determine the body composition and obesity of children in grades 7-12 and its relationship with their physical activity through body composition analysis and statistical procedures.*

Key words: *body fat, muscle mass, health status, physical development.*

1. Introduction

Human development goes hand in hand with scientific and technical progress, and although it brings significant benefits to society, it also has its downsides. One of these bad practices is the sedentary lifestyle that leads to overweight and obesity. This is the result of many factors, among them hemodynamic and the mass production of low-nutrient, high-fat foods [6], [15]. Obesity is a serious problem for public health and threatens the viability of essential primary health care in many countries. It is an independent risk factor for cardiovascular diseases and significantly increases the risk of morbidity and mortality. Nowadays the problem with obesity is even worse as we can observe more and more related health

problems among children and adolescents.

Many co-morbid conditions connected with all aspects of human health are associated with childhood obesity.

From our perspective treating overweight and obesity in children and adolescents requires a multidisciplinary and multi-phase approach, which includes a better diet and greater physical activity. Research has even shown that childhood obesity leads to poor lifestyles and a significant increase in healthcare costs in the future.

Some authors have examined the question of obesity and immobility among the Bulgarian population, and they have concluded that overeating, lack of physical activity, or role models are the main factors for overweight in adolescents [1], [11].

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2. Objectives

From that point of view, the study aims to determine the body composition and obesity of the examined children and relate it to their physical activity.

3. Material and Methods

We measured 317 children (183 girls and 134 boys) with a mean age of 12.8 years $\pm 0,8$ months. They have a BIA (bioelectrical impedance analysis) with an InBody BIA device; model InBody 230 (InBody USA, Cerritos, CA). The device utilizes hand-to-foot BIA that sends varying frequencies of alternating current through the body. The BIA technique is reliable and valid for estimating human body composition. This method provides fast results and at the same time requires little operator skill and subject cooperation [10].

These impedance values are then used to predict several variables, including BF%,

FM, FFM, and TBW. The InBody analyzer utilizes a tetra polar 8-point tactile electrode system. The InBody 230 takes ten impedance measurements with two frequencies (20 and 100 kHz) [3,7].

The data that we measured was Weight; TBW (Total body water); Protein; Minerals; BFM (Body fat mass); FFM (Fat-free mass); SMM (Skeletal muscle mass); BMI (Body mass index); PBF (Percent body fat); Obesity degree of a child. Every parameter has a lower limit (under the normal distribution range) and an upper limit (over the normal distribution range), depending on the height and the age of the investigated person.

Descriptive statistics were used to analyze the results, including mean value and standard deviation.

4. Results and Discussions

The results of the study are shown in Tables 1, 2 and 3, which summarize all the individuals studied.

Summarized values of the researched indicators for all students

Table 1

| Indicators | Height (cm) | Age | Weight (kg) | TBW (Total Body Water) | Protein | Minerals | BFM (Body Fat Mass) (kg) | FFM (Fat-Free Mass) (kg) | SMM (Skeletal Muscle Mass) (kg) | BMI (Body Mass Index) | PBF (Percent Body Fat) (%) | Obesity Degree of a Child (%) |
|------------|-------------|------|-------------|------------------------|---------|----------|--------------------------|--------------------------|---------------------------------|-----------------------|----------------------------|-------------------------------|
| X | 162,3 | 12,9 | 51,7 | 29,7 | 7,9 | 2,8 | 11,2 | 40,5 | 22,0 | 19,5 | 20,6 | 94,2 |
| Min | 130,0 | 10,9 | 24,8 | 15,5 | 4,0 | 1,5 | 1,2 | 21,0 | 10,4 | 11,7 | 3,0 | 56,0 |
| Max | 191,0 | 45,0 | 95,1 | 52,8 | 14,2 | 5,3 | 40,7 | 71,7 | 40,9 | 33,9 | 50,0 | 163,0 |
| S | 8,7 | 2,0 | 12,1 | 5,8 | 1,6 | 0,6 | 6,8 | 8,0 | 4,8 | 3,5 | 8,7 | 16,7 |

Summarized values of the researched indicators for boys

Table 2

| Indicators | Height (cm) | Age | Weight (kg) | TBW (Total Body Water) | Protein | Minerals | BFM (Body Fat Mass) (kg) | FFM (Fat-Free Mass) (kg) | SMM (Skeletal Muscle Mass) (kg) | BMI (Body Mass Index) | PBF (Percent Body Fat) (%) | Obesity Degree of a Child (%) |
|------------|-------------|------|-------------|------------------------|---------|----------|--------------------------|--------------------------|---------------------------------|-----------------------|----------------------------|-------------------------------|
| X | 163,4 | 12,8 | 53,3 | 31,5 | 8,4 | 3,0 | 10,4 | 42,8 | 23,4 | 19,7 | 18,6 | 95,8 |
| Min | 144,0 | 11,3 | 31,7 | 19,4 | 5,1 | 1,8 | 1,2 | 26,5 | 13,4 | 14,7 | 3,0 | 69,0 |
| Max | 191,0 | 14,3 | 87,0 | 52,8 | 14,2 | 5,3 | 33,7 | 71,7 | 40,9 | 29,8 | 50,0 | 148,0 |
| S | 10,1 | 0,8 | 13,3 | 7,1 | 1,9 | 0,7 | 6,9 | 9,7 | 5,9 | 3,6 | 9,3 | 16,7 |

Summarized values of the researched indicators for girls

Table 3

| Indicators | Height (cm) | Age | Weight (kg) | TBW (Total Body Water) | Protein | Minerals | BFM (Body Fat Mass) (kg) | FFM (Fat-Free Mass) (kg) | SMM (Skeletal Muscle Mass) (kg) | BMI (Body Mass Index) | PBF (Percent Body Fat) (%) | Obesity Degree of a Child (%) |
|------------|-------------|------|-------------|------------------------|---------|----------|--------------------------|--------------------------|---------------------------------|-----------------------|----------------------------|-------------------------------|
| X | 161,3 | 12,9 | 50,5 | 28,4 | 7,6 | 2,8 | 11,7 | 38,8 | 20,9 | 19,3 | 21,9 | 93,0 |
| Min | 130,0 | 10,9 | 24,8 | 15,5 | 4,0 | 1,5 | 2,0 | 21,0 | 10,4 | 11,7 | 7,2 | 56,0 |
| Max | 178,0 | 45,0 | 95,1 | 41,8 | 11,1 | 4,2 | 40,7 | 57,0 | 31,6 | 33,9 | 44,1 | 163,0 |
| S | 7,4 | 2,5 | 11,1 | 4,3 | 1,2 | 0,5 | 6,7 | 5,9 | 3,5 | 3,5 | 8,0 | 16,6 |

| | | | | | | | | | | | | |
|-----|-------|------|------|------|------|-----|------|------|------|------|------|-------|
| X | 161,3 | 12,9 | 50,5 | 28,4 | 7,6 | 2,8 | 11,7 | 38,8 | 20,9 | 19,3 | 21,9 | 93,0 |
| Min | 130,0 | 10,9 | 24,8 | 15,5 | 4,0 | 1,5 | 2,0 | 21,0 | 10,4 | 11,7 | 7,2 | 56,0 |
| Max | 178,0 | 45,0 | 95,1 | 41,8 | 11,1 | 4,2 | 40,7 | 57,0 | 31,6 | 33,9 | 44,1 | 163,0 |
| S | 7,4 | 2,5 | 11,1 | 4,3 | 1,2 | 0,5 | 6,7 | 5,9 | 3,5 | 3,5 | 8,0 | 16,6 |

From our point of view, this is one of the first studies that aims to check the health status and the level of obesity of Bulgarian students in the city of Sofia. As we have already mentioned, such studies have been done for Bulgaria, but not from the point of view of the variety of indicators that characterize it. The previous results show that in Bulgaria and the Republic of Macedonia, the prevalence of severe obesity was similar to Southern European countries (4,0 and 4,4%, respectively), Moldova and Albania had values among the lowest (1,0 and 1,2%, respectively) [16].

The influencing factors that lead to obesity or overweight are many and most diverse -are genetic, socio-economic, religious, cultural, ethnic, etc. [8].

Every hour of sedentary activity increases the chance of obesity and contributes to the failure of many weight reduction attempts in adolescents and children. Screen time should be restricted to less than two hours per day as the opposite is associated with increased adiposity and higher weight status [12].

Moderate intensity regular physical

activity is essential for the prevention of overweight and obesity as well as for treatment of the same [17].

From scientific research, we know that genetic factors play both a direct and indirect role in our metabolism and our behavior regarding energy intake and expenditure [13]. These factors, although interesting, need to be sufficiently widely recommendations like those of the WHO are followed.

The range of typical values of every parameter depends on the height and the age of the investigated child. So the average range of the weight of all children is between 47,37 kg. to 64,08 kg. Under this range, the children are underweight; over that range, they are overweight.

In presented Fig.1, we show that 53% of all students have average body weight, 36 % have underweight and only 10% have overweight. This was separated by gender, and 56% of girls have an average body weight relative to 50% of boys. 39% of the investigated boys are underweight, and only 11% are overweight, close to girls, who are 34% underweight and 10% overweight.

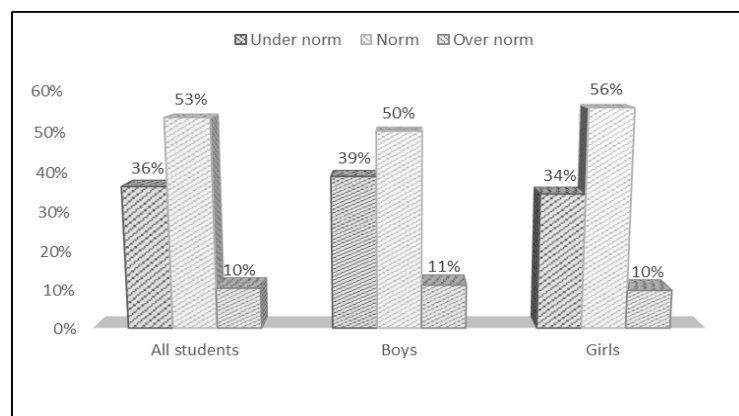


Fig. 1. *Body weight of all students, boys, and girls, separated by weight norms for underweight and overweight.*

Respectively the BMI has relatively equal values to these of body weight. More than half (51%) of all students have typical values of BMI, and only 11% have values

over the normal. These parameters and ratios like these of body weight we present in Figure 2.

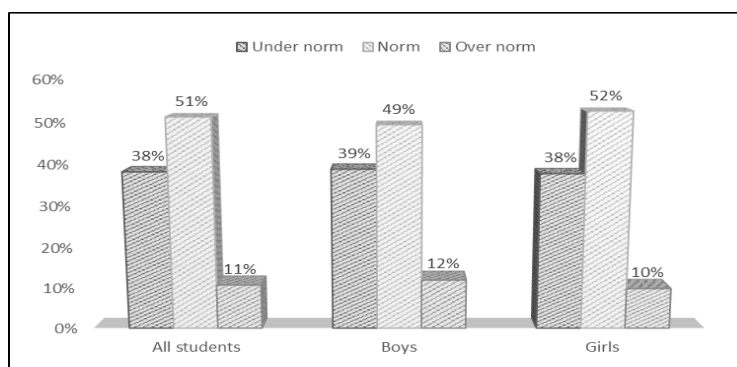


Fig. 2. BMI (Body mass index) of all students, boys and girls, separated by BMI norms.

The body mass index (BMI) is a value obtained when we divide the weight in kilograms by the height in meters raised squared. Body mass is a general term for total body composition and includes fat, muscle, and bone. This method is one of the best for screening obesity and overweight. Despite its popularity, BMI has one main drawback, namely the impossibility of distinguishing body fats and muscular tissues. [4], [5], [14]. It is important to note that BMI does not differentiate between body dry mass and body fat mass.

Authors define bioelectrical-impedance-analysis (BIA) as method for accurate measurement of body composition in healthy subjects. One study validates the use of BIA to measure the change in body composition and predicted change in fat-free mass with greater accuracy and precision than anthropometry did [16].

· In this regard, in the foreign literature

on the subject, there is more and more data from scientific studies in which BMI is divided into an index of active body mass and an index of adipose tissue [9]. According to evaluation data of an expert group from the WHO, the level of physical activity in 2/3 of the population over 15 years of age in EU countries is below the recommended level [2].

In Figure 3, we presented all the parameters we measured of all children over body weight, which is 10,4% of all measured persons. On 88% of them, we measured BFM over the norm and only 12% in the middle; on 39% - FFM over the norm and 61% in the middle; on 94% - PBF over the standard and 6% in the norm.

On the parameter "Obesity degree of a child" we could conclude that 55% of the overweight child are over the norm, 21% are within the norm, and 24% are under the norm.

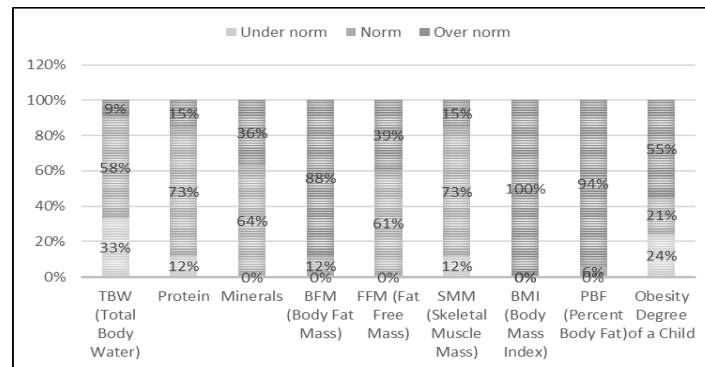


Fig. 3. *Distribution of the studied parameters in overweight children*

In addition to this analysis, we should do one for the examined children with normal body weight and BMI. These values we illustrate in Figure 4.

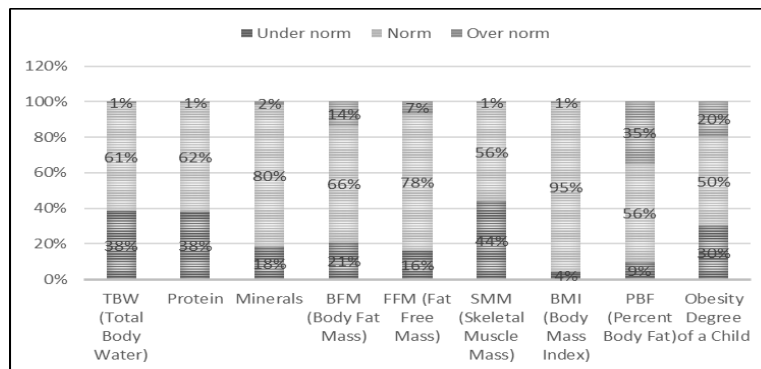


Fig. 4. *Distribution of the studied parameters children with average weight*

This group of children with average weight has cases of children with BFM over the norm (14%) and PBF again over the norm (35%). This parameter is reflected in the parameter "Obesity degree of a child" and in this group, we have 20% of children with values over the norm, 50% in the norm, and 30% under the norm.

5. Conclusions

Based on the research, we can draw the following conclusions:

1. The tendency to increase the number of obese and overweight children, which

according to our study, is about 20% of the studied group, is confirmed.

2. Apart from these results in the segmental analysis, we can notice that despite the normal security according to BMI, the students in Sofia have a high percentage of body fat, which overlaps with the perception of improper nutritional intake.

These conclusions require the recommendation to improve the diet of adolescent students and increase energy expenditure by increasing motor activity.

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