ASSESSMENT OF BODY COMPOSITION IN PRESCHOOL CHILDREN

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Abstract: Differences in body composition typically begin to appear around the age of three. It is during this period that children experience various growth spurts and developmental changes that can impact body composition. The research was conducted at the preschool institution "Čika Jova Zmaj" in Bijeljina, using empirical and statistical methods, and was a cross-sectional study in terms of duration. Body composition analysis was performed using the Tanita TBF 300 bioelectrical impedance on 130 six-year-old participants. The study included 70 girls and 60 boys. Analyzing the results related to differences in body composition in preschool children at both univariate and multivariate levels between boys and girls, based on Wilks' Lambda and the F-test, a statistically significant F ratio (8.859) was observed at the strictest significance level $p < 0.01$, specifically $P = 0.000$. The differences obtained in this study can be explained by biological, hormonal, and genetic factors, as well as social influences. To ensure a healthy body composition in preschool children, several key factors need to be considered, including: regular physical activity, a balanced diet, control of multimedia content such as phones, TV, and computers, and parental involvement.

Keywords: Body composition, preschool age, differences.

1. INTRODUCTION

Overweight and obesity in childhood have reached epidemic proportions; it is estimated that around 6 percent, or 39 million children under the age of 5, were obese worldwide by 2020, with a rapid increase of nearly 6 million children compared to 2000 (UNICEF, 2021). The rising obesity rates during this period represent a significant health concern with serious psychosocial and economic consequences (Grant-Guimaraes, Feinstein, Laber, & Kosoy, 2016; Browne, 2017). Body composition in preschool-aged children is a key aspect of child development that relates to the proportion of fat, muscle, and other tissues in the body. Understanding this composition is essential for assessing health, monitoring growth, and developing effective programs to promote healthy growth patterns and development. Body composition in children can vary significantly due to several factors, including age, sex, genetics, physical activity, nutrition, and socioeconomic status. Differences in body composition typically begin to appear around the age of three. It is during this period that children experience various growth spurts and developmental changes that can affect body composition. Numerous factors influence body composition during this age. Primarily, nutrition plays a crucial role. A well-balanced diet rich in essential nutrients supports healthy growth and body composition (de Bona Coradi, Anele, Goldani, da Silva, & Bernardi, 2023). Studies show that boys typically develop more muscle mass compared to girls, who may have a higher percentage of body fat (Mahapatra & Bose, 2023). These differences can be attributed to internal factors, such as hormonal influences, particularly the effect of testosterone in boys, which stimulates muscle growth more efficiently than in girls. Additionally, variations in body composition can be observed as children transition from an infantile body type, characterized by a higher proportion of body fat and relatively smaller muscle mass, to a composition more akin to that of adults. This evolution typically involves a gradual increase in muscle mass, especially between the ages of three and five, when children actively engage in physical activities and other playful movements that enhance muscle development. Children from lower socioeconomic backgrounds often experience higher rates of obesity and health problems related to obesity due to limited access to healthy food and safe spaces for physical activity (Nattagh-Eshtivani, Pahlavani, Khosravi, Sarivi, Hakkak, & Maddahi, 2024). Several factors play a significant role in shaping body composition in preschool-aged children: genetics, participation in physical activities, dietary habits, and socioeconomic factors. Genetic predispositions are a key determinant of body composition. The inherited balance of body fat and muscle mass can affect a child's physical development. Children often inherit body shapes, metabolism, and tendencies to accumulate muscle or fat from their parents.

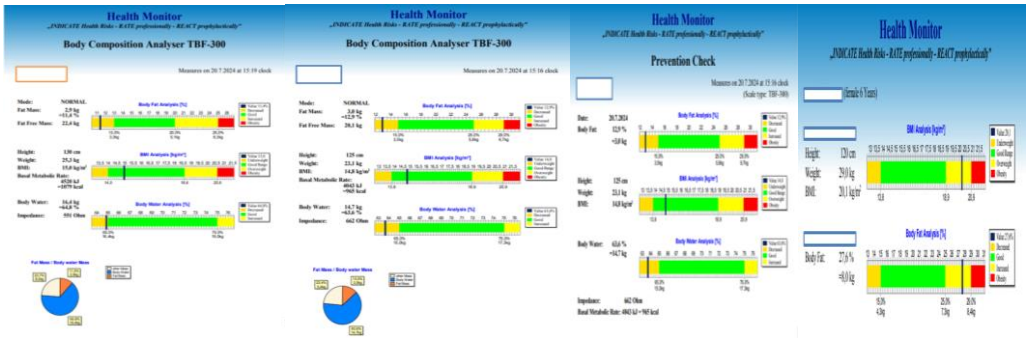
Physical activity is essential for promoting healthy body composition. Active children typically show lower levels of body fat and greater muscle mass. Basic physical activities during this period not only help develop muscle strength but also improve overall fitness levels. On the other hand, a sedentary lifestyle, which is common among children who spend too much time in front of screens, can lead to unfavorable changes in body composition. Dietary habits during preschool age significantly impact body composition. A balanced diet rich in nutrients is key for optimal

growth and development. Children who have access to a more varied diet, including fruits, vegetables, grains, and healthy fats, are more likely to have a healthy body composition compared to those who consume large amounts of sugar and processed foods. Inadequate nutrition can lead to weight problems, including obesity or malnutrition. Socioeconomic factors can influence both diet and physical activity levels in children. Families with limited resources may have difficulties providing nutritious foods or opportunities for physical activities, leading to differences in body composition among children from different socioeconomic backgrounds. Studies show that children from lower socioeconomic strata are more likely to be overweight due to factors such as food insecurity and lack of safe spaces for physical activity (Kędzior et al., 2017; Due et al., 2009; Mikoś et al., 2010). The aim of this study was to scientifically analyze body composition in preschool children from the area of the city of Bijeljina (Republic of Srpska).

2. METHOD

The research was conducted at the preschool institution "Čika Jova Zmaj" in Bijeljina using empirical and statistical methods, and it was a cross-sectional study in terms of its duration. Body composition analysis was performed using bioelectrical impedance with the Tanita TBF 300 device on 130 participants aged six years. The study included 70 girls and 60 boys. The instrument assesses body composition structure by emitting a low, safe dose of current (800μA) through the body. The current passes through the body without resistance from muscles, while resistance occurs when the current passes through fat tissue. The athletic and standard modes allow for detailed analysis of the health and condition of the body, incorporating all parameters. Tanita uses software that takes data such as gender, height, weight, and activity level (athletic or standard mode). Based on the entered data, the software calculates the percentage of fat and other components in the body composition for each child.

Figure1: The data processing methods included the calculation of basic descriptive statistics, testing for normality of distribution, and analysis of differences between boys and girls of preschool age.



Source: Author research

3. RESULTS

Table 1. Basic Descriptive Statistics and Normality of Body Composition Distribution for Boys

Variable	Min	Max	AS	SD	Skew	Kurt	KS-p
Body Fat Percentage	6,4	33,2	18,02	6,71	0,649	-0,479	0,880
Fat Mass Weight	1,8	17,8	7,10	3,42	0,978	0,988	0,554
Lean Mass	14,0	27,2	21,80	2,45	0,799	0,077	0,521
Body Water Percentage	54,8	77,8	59,50	4,62	-0,697	-0,501	0,922
Body Water Weight	15,4	26,3	21,94	2,88	0,070	0,080	0,911
Basal Metabolism	980	1512	1050	112,20	0,781	0,410	0,059

Source: Author research

Legend: N – Number of participants; Min – Minimum measured values; Max – Maximum measured values; AS – Arithmetic mean; SD – Standard deviation; Skew – Skewness – measure of the symmetry of the distribution; Kurt – Kurtosis – measure of the homogeneity of the distribution; p – Level of statistical significance of the Kolmogorov-Smirnov Z coefficient.

The results in Table 1 indicate good discriminative ability of the measurements in most variables. A poorer relationship between the arithmetic mean and standard deviation is present only in two variables: Percentage of body fat and Body fat weight. In these variables, it was not possible to fit three standard deviations within one arithmetic mean. The range of results is compromised in most variables because it is not possible to fit 5 to 6 values of standard deviation into one range value. The shape measure of the distribution, skewness, shows satisfactory results in all analyzed variables. All results are within the allowed coefficients. The homogeneity of the data distribution, expressed through kurtosis, indicates good homogeneity in all analyzed variables. Data on the values of the KS test and its significance allow further use of parametric methods, as the normality of distribution was not violated in any variable.

Table 2. Basic Descriptive Statistics and Normality of Body Composition Distribution for Girls.

Variable	Min	Max	AS	SD	Skew	Kurt	KS-p
Body Fat Percentage	4,2	43,1	23,02	8,12	0,040	0,119	0,940
Fat Mass Weight	1,2	18,4	9,10	5,36	0,719	2,554	0,800
Lean Mass	20,2	33,8	22,78	4,32	0,932	0,676	0,390
Body Water Percentage	39	75,3	60,01	7,18	-0,070	0,239	0,957
Body Water Weight	15,1	33,1	23,30	5,23	0,929	0,587	0,341
Basal Metabolism	848	1520	1079	103,31	0,457	2,121	0,332

Source: Author research

Legend: N – Number of participants; Min – Minimum measured values; Max – Maximum measured values; AS – Arithmetic mean; SD – Standard deviation; Skew – Skewness – measure of the symmetry of the distribution; Kurt – Kurtosis – measure of the homogeneity of the distribution; p – Level of statistical significance of the Kolmogorov-Smirnov Z coefficient.

The results in Table 2 indicate good discriminative ability of the measurements in most variables. A poorer relationship between the arithmetic mean and standard deviation is also present in this case for girls in only two variables: Percentage of body fat and Body fat weight. In these variables, it was not possible to fit three standard deviations within one arithmetic mean. The range of results is compromised in most variables, except in the variables (Percentage of water in the body and Basal metabolic rate) because in the other variables, it was not possible to fit 5 to 6 standard deviation values into one range value. The shape measure of the distribution, skewness, shows satisfactory results in all analyzed variables. All results are within the allowed coefficients. The homogeneity of the data distribution, expressed through kurtosis, indicates good homogeneity in all analyzed variables. A leptokurtic distribution shape is expressed in two variables: Body fat weight and Basal metabolic rate. Based on the significance of the Kolmogorov-Smirnov test, it is observed that there is no statistically significant deviation in any variable, allowing for further use of parametric data processing techniques.

Table 3. Difference in body composition between boys and girls of early school age.

Variable	f	p
Body Fat Percentage	3,899	**0,031**
Fat Mass Weight	3,887	**0,039**
Lean Mass	0,581	0,640
Body Water Percentage	1,060	0,066
Body Water Weight	0,572	0,656
Basal Metabolism	4,766	**0,041**

Source: Author research

Legend: f – value of the univariate F-test; p – statistical significance of the univariate F-test; F – value of the multivariate Wilks' test; P – statistical significance of the multivariate Wilks' test.

$$F = 8{,}859 \qquad P = 0{,}000$$

The results presented in Table 3, which refer to differences in body composition among preschool children at the univariate and multivariate levels between boys and girls, based on the Wilks' F-test, show statistical significance of the F ratio (8.859) at the most stringent level of inference $p < 0.01$, specifically $P = 0.000$. When observing each variable individually, significant differences are noted in the variables: body fat percentage, body fat weight, and basal metabolic rate, with statistical significance at $p < 0.01$ in favor of girls. It is observed that, on average, girls

have higher values than boys in nearly all variables, indicating that girls are more overweight than boys and have a higher percentage of body fat.

4. DISCUSSION

Considering the results obtained in this study, it can be concluded that there are statistically significant differences in favor of girls. However, since the variables assessed are related to body composition, it must be noted that sometimes a better result is actually worse, especially when it comes to variables such as body fat percentage and body fat weight, as is the case in this study. Higher results in girls indicate that boys tend to have a better body composition in comparison. Similar findings are reported in other studies (Lemieux et al., 1993; Castetbon & Andreyeva, 2012; Pelemiš, Pavlović, Mitrović, Nikolić, Stević, & Trajković, 2024). Sexual differences in muscle mass become evident during puberty, with boys typically having a greater proportion of muscle compared to girls (Kanehisa et al., 1994). During prepuberty and puberty, boys usually experience a faster and more pronounced increase in muscle mass due to higher levels of testosterone, a hormone that plays a key role in muscle growth and development. Research has shown that boys have a higher proportion of skeletal muscle in total body mass, which contributes to stronger physical endurance and performance in sports activities. Biologically, girls tend to accumulate more body fat, especially during puberty, which is necessary for reproductive functions. This difference in body fat can be viewed as an adaptation for reproduction, while the higher muscle proportion in boys may contribute to their ability to perform better in physical activities. For example, the average body fat percentage in boys can range from 15-20%, while in girls, it is usually around 20-25%. The differences observed in this study can be explained by biological, hormonal, and genetic factors, as well as social influences.

5. CONCLUSION

To ensure a healthy body composition in preschool children, several key factors must be considered: regular physical activity, following the recommendations of the WHO (2023) for a minimum of 60 minutes of intense physical activity daily, balanced nutrition, control of multimedia content, including phones, TV, and computers, and parental involvement. Encouraging daily physical activity through structured play, sports, or unstructured outdoor activities is essential for developing motor skills and maintaining healthy levels of body fat. A well-balanced diet, which includes adequate amounts of protein, carbohydrates, fats, vitamins, and minerals, supports the overall health of children and the maintenance of a healthy body composition. Limiting the intake of sweeteners and high-calorie snacks is also important. Monitoring and limiting screen time, as well as promoting alternative forms of entertainment that encourage movement, can positively influence children's body composition. Parents who prefer healthy habits in diet and active living are likely to inspire similar habits in their children, thereby promoting healthier body composition.

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