

**BODY COMPOSITION OF SCHOOL AGE CHILDREN IN BOSNIA AND HERZEGOVINA****Erol Kovačević<sup>1</sup>, Denis Čaušević<sup>1</sup>, Yunyou Liu<sup>2</sup>, Josipa Nakić<sup>3</sup>, Nedim Čović<sup>1</sup>, Elvir Kazazović<sup>1</sup>, Ensar Abazović<sup>1</sup>**<sup>1</sup> Faculty of Sport and Physical Education, University of Sarajevo, Sarajevo<sup>2</sup> College of Physical Education and Health Sciences, Zhejiang Normal University, China<sup>3</sup> Faculty of Kinesiology, University of Zagreb, Croatia

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Original scientific paper

**Abstract**

Considering the growing global problem and the lack of obesity data in Bosnia and Herzegovina (BH) the main aim of this paper was to determine BH school-age children body composition and determine the differences in body composition between girls and boys classified in underweight, normal weight and overweight according to the body mass index (BMI) score. 2524 participants 1763 girls and 761 boys (aged 10-13 yrs.) from 32 elementary schools were randomly selected and divided to 3 BMI groups by WHO cut-off points. InBody 370 Body Composition Analyzer (BioSpace, Seoul, Korea), a segmental bioelectrical impedance analysis (BIA) device was used to gather data. The results showed ~38% of the sample were classified as overweight whilst gender differences showed higher body fat mass and fat percentages in arms, trunk and legs in underweight and normal weight girls and higher skeletal muscle mass in normal weight and overweight boys.

**Key words:** *Bioelectrical impedance, Obesity, Gender difference, Body mass index***Introduction**

Obesity in the younger school population is becoming a burning topic today, given that numerous studies show a tendency for the obesity rate of the young population to increase (Verduin et al. 2016; Brady, T. M. 2017; Chen et al. 2018; Hanlon et al. 2019). Weight gain and obesity are defined by the World Health Organization as abnormal and / or excessive accumulation of adipose tissue that poses a health risk (WHO, 1997). In adults, overweight and obesity increase the risk of coronary heart disease, type 2 diabetes, gall bladder disease, hypertension and some forms of cancer. However, although the association of obesity in children with adult obesity has been inadequately investigated research by Serdula et al. 1993 points to the fact that increased body fat in youth is a contributing factor for obesity in adulthood. This is supported by the fact that every sixth person between the ages of 2 and 19, or 12.7 million are currently overweight or obese (Ogden et al. 2015).

Given the above, the question arises about the actual state of body composition of children in BiH. Given the significant health implications as well as the rapid growth of obesity in the world, this problem is receiving increasing attention, but there are still different approaches to collecting, processing and interpreting the results which can be an additional problem. At the level of Bosnia and Herzegovina, there are no exact epidemiological data on the number of overweight and obese people, and it is quite clear that it is not possible to

say with certainty what the prevalence is in a subsample or population. A special problem is the small number of researches in BiH that have dealt with this issue. At the moment, several scientifically verified and published data are available (Kovačević et al. 2018; Čolakhodžić et al. 2017; Abazović et al. 2016; Abazović et al. 2017; Mesihović-Dinarević et al. 2011) refer to the population of children and adolescents.

The aim of this paper, therefore, was to determine the body composition of school-age children in Bosnia and Herzegovina aged 10 - 13 yrs. and the differences in body composition between girls and boys classified in underweight, normal weight and overweight according to the body mass index score.

**Methods***Participants*

In order to establish reference ranges 2524 participants (Table 1, 763 girls and 761 boys; aged 10.66±0.64 (mean±SD)) from 32 elementary schools in Sarajevo Canton were randomly selected to participate in this study. Sample was furtherly sub grouped in 3 weight categories according to World Health Organization by BMI cut-off points: normal weight (NW); overweight (OW), underweight (UW). After study approval by the local Ethics Committee and local Ministry of Education, parents written consent were obtained.

### Equipment and procedure

Body composition was evaluated using InBody 370 Body Composition Analyzer (BioSpace, Seoul, Korea), a segmental bioelectrical impedance analysis (BIA) device measuring the voltage drop in upper and lower body. The participant stood on the device and held the hand electrodes while it measured body composition. Participants age, height and sex were entered on the touch screen. The InBody uses eight points of tactile electrodes (contact at the hands and feet) which detect the amount of segmental body water using multiple frequencies to measure intracellular and extracellular water separately. The frequency of 50 kHz measures extracellular water while frequencies above 200 kHz measure intracellular water. Segmental analysis can calculate slight differences by sex, age and race without using empirical estimation. Body weight was measured to the nearest 0.05 kg in a swimming suit, and body height was measured with a microtoise to the nearest 1 mm. In total 18 whole and segmental body composition parameters were obtained.

### Statistical analysis

Data were analyzed using SPSS statistical software (ver. 23.0, IBM Corp. New York). Normality of data distribution was inspected using Kolmogorov – Smirnov test. Mean values and standard deviation (mean±SD) were calculated for all data. Overall differences between boys and girls for each weight category was determine using independent T-test sample. Statistical significance was set at conventional 95% ( $p < 0.05$ ).

### Results

When sub grouped by BMI cut off point there were in total 130 underweighted, 822 with normal weight and 823 overweighed girls and boys (Table 2). For participants in underweight group female share was higher by 6.6% ( $p < 0.05$ ) compared to male, while in overweight group male share was 8.2% ( $p < 0.05$ ) higher compared to female.

Table 1. Age, height, weight and BMI for overall sample, female and male subgroups.

	Girls (N=763)				Boys (N=761)				Total			
	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD
Age	10	13	10.62	.62	10	13	10.70	.65	10	13	10.66	.64
Height	124.60	173.60	149.29	7.50	126.00	189.40	149.31	7.87	124.60	189.40	149.29	7.68
Weight	22.10	81.70	43.63	10.45	25.00	100.90	45.47	11.44	22.10	100.90	44.55	10.99
BMI	12.60	33.80	19.41	3.58	12.20	38.10	20.19	3.7	12.20	38.10	19.79	3.71

Underweighted girls had significantly lower total body fat mass and fat percentage (0.77 kg and 2.62%;  $p < 0.001$ ), arms fat mass and fat percentage (0.06 kg and 4.15 %;  $p < 0.001$ ), trunk fat mass and fat percentage (0.44 kg and 3.03 %;  $p < 0.001$ ) as well as leg fat mass and fat percentage (0.1 and 2.95 %;  $p < 0.001$ ).

In participants with normal weight boys had significantly higher soft lean mass (0.83 kg,  $p < 0.001$ ), fat free mass (0.85 kg,  $p < 0.001$ ), skeletal muscle mass (0.56 kg,  $p < 0.001$ ) as well as arms and trunk fat free mass (0.07 kg,  $p < 0.001$  and 0.31 kg  $p < 0.05$ ).

Likewise in underweight group, girls had higher body fat mass and fat percent (1.31 kg and 3.07%,  $p < 0.001$ ) arms fat mass and fat percentage (0.1 kg and 4.75 %;  $p < 0.001$ ), trunk fat mass and fat percentage (0.75 kg and 3.82 %;  $p < 0.001$ ) as well as leg fat mass and fat percentage (0.17 and 2.73 %;  $p < 0.001$ ).

In overweight group boys had higher skeletal muscle mass (0.57 kg,  $p < 0.001$ ) and legs fat free mass (0.26 kg,  $p < 0.001$ ). Waist to hip ratio was significantly higher in girls for each weight subgroup.

No differences were seen between female and male participants for age and height by weight categories.

Table 2. Differences between female and male participants in body composition according to BMI cut off points.

	Underweight (mean±SD)		Normal weight (mean±SD)		Overweight (mean±SD)	
	Girls (N=90)	Boys (N=40)	Girls (N=418)	Boys (N=404)	Girls (N=255)	Boys (N=317)
Total body water	19.28±2.33	19.99±2.02	22.29±3.13	22.92±3.24	25.93±3.75	26.61±4.39
Body fat mass	5.02±1.16**	4.25±1.12	9.30±2.74**	7.99±2.66	19.13±5.62	19.27±6.55
Soft lean mass	24.73±2.99	25.65±2.61	28.59±4.02 <sup>§§</sup>	29.42±4.15	33.29±4.82	34.15±5.64
Fat free mass	26.25±3.15	27.22±2.75	30.36±4.26 <sup>§§</sup>	31.21±4.39	35.37±5.13	36.26±6.00
Skeletal muscle mass	13.48±1.87	14.08±1.63	15.91±2.50 <sup>§§</sup>	16.47±2.61	18.90±3.04	19.47±3.54
Body mass index	14.81±0.56	14.86±0.66	17.91±1.30	17.96±1.32	23.47±2.80	23.83±2.99
Percent body fat	16.10±3.47**	13.48±3.22	23.28±5.39**	20.21±5.49	34.69±6.03	34.16±6.89
Arms fat free mass	0.89±0.18 <sup>§§</sup>	0.94±0.17	1.19±0.26 <sup>§§</sup>	1.26±0.28	1.63±0.34	1.69±0.39
Trunk fat free mass	10.90±1.38	11.17±1.26	12.87±1.83 <sup>§</sup>	13.18±1.92	15.71±2.28	16.09±2.58
Legs fat free mass	3.68±0.75	3.90±0.58	4.40±0.85 <sup>§</sup>	4.55±0.89	5.23±0.92	5.49±1.12
Arms body fat mass	0.43±0.08**	0.37±0.09	0.66±0.19**	0.56±0.18	1.39±0.54	1.39±0.63
Arms percent body fat	31.67±7.20**	27.52±7.25	34.23±7.43**	29.48±7.67	43.19±7.24	41.96±8.56
Trunk body fat mass	1.31±0.64**	0.87±0.57	3.81±1.57**	3.06±1.51	9.30±2.97	9.28±3.35
Trunk percent body fat	10.12±4.49**	7.09±3.82	21.24±6.68**	17.42±7.05	35.18±5.99	34.46±6.92
Legs body fat mass	1.05±0.18**	0.95±0.19	1.66±0.40**	1.49±0.39	3.01±0.77	3.09±0.95
Legs percent body fat	21.73±5.04**	18.78±3.78	26.42±5.30**	23.69±5.31	35.07±5.79	34.45±6.45
Basal metabolic rate	936.92 ±68.14	958.02 ±59.32	1025.84 ±91.97 <sup>§§</sup>	1044.03 ±94.89	1133.88 ±110.78	1153.30 ±129.53
Waist-Hip ratio	0.78±0.03**	0.76±0.01	0.79±0.03**	0.77±0.02	0.85±0.05*	0.84±0.05

\*\* significantly higher in girls  $p<0.01$ ; <sup>§§</sup> - significantly lower in girls  $p<0.01$ ; \* - significantly higher in girls  $p<0.05$ ; <sup>§</sup> - significantly lower in girls  $p<0.05$

## Discussion

Study aimed to determine body composition parameters in children in age span from 10 to 13 years. Additionally, sample was divided according to BMI, and body composition parameters were compared between boys and girls. This study found that underweight girls and girls with normal BMI had significantly higher body fat mass and fat percentages in arms, trunk and legs compared to underweight boys. Boys with normal weight had significantly higher soft lean mass as well as overall and segmental muscle mass. Differences found in overweight group were small and did not reach significant importance except waist to hip ratio which was higher in girls for each weight group.

Since prevalence of overweight and obesity is increasing (Flegal et al. 2001; Padez et al. 2004; Wang et al. 2002) findings of our study align with this since around 38 % of the sample presented were classified as overweight. Further, comparison of our results with those from other countries has shown that prevalence of overweight and obesity in our research were higher than in some European countries, USA and some Asian countries (Farsi et al. 2016; Dereñ et al. 2018; Ogden et al. 2006; Larrañaga et al. 2007). Such results may be caused by lifestyle habits, hypokinesia and the level of country development (James, P. T., 2004).

This study was first comprehensive study that assessed body composition differences in school children from Bosnia and Herzegovina according to the level of obesity (BMI). Results show no superiority in fat percentage differences between boys and girls in relation to clinical significance with

mean difference around 1-2%. Differences between girls and boys in fat percentage divided by different BMI were noted in previous research (Maynard et al., 2001) and BMI is a suitable measure of adiposity due to high correlation with body fat percentage. Taller girls compared with their male peers tended to have excess of body fat at the same age and sex (Himes and Roche, 1986). These differences in body fat percentage, begins to appear at onset of puberty (Deurenberg et al, 1990). The higher body fat percentage at low BMI in females could be explained by differences in body build, more specifically differences in relative body height and the level of soft lean mass due to different level of activity and hormonal status in prepuberty boys (James, P. T., 2004).

This study did not examined causes for the differences found and it can only be speculated that the reasons for such results might be the same like in the previous studies (Maynard et al., 2001; Deurenberg et al., 2003). Measurements on body composition using reference methods were performed. Study had obtained huge presence of obesity and overweight in boys and girls in Bosnia and Herzegovina. Result of specific body composition data that will facilitate the prevention of obesity in school children of Bosnia and Herzegovina.

## Conclusion

Study revealed high presence of obesity in school age children in Bosnia and Herzegovina. This study shows that underweight girls have higher body fat percentage compared to boys, while boys with normal weight tended to have higher soft lean mass and fat free mass at same weight and height.

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