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Original Article

Body Composition of Children in the Pre-pubertal and Early-pubertal Period: Are There Some Age-related and Intersexual Differences?

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Abstract

The aim of the presented study was to assess changes in body composition and intersexual differences among children at pre-pubertal and early-pubertal age. The research was designed as a non-randomized cross-section study. The screened sample consisted of 136 girls and 212 boys assigned into three groups according to their age. Body composition was measured using a direct segmental multi-frequency bioelectrical impedance analysis (DSM-BIA). To examine the association between obesity and selected health-related parameters, Kruskal-Wallis ANOVA and Eta2 were used. For evaluation of intersexual differences, Mann-Whitney U-test was used. The presented article is the part of VEGA 1/0840/17 project. From the perspective of age, neither in the group of girls nor boys we recorded any differences in indicators of body composition, namely in body fat mass index, body fat percentage and, in addition, in the group of girls in the waist to hip ratio parameter.

1. Introduction

Monitoring the prevalence of overweight and obesity is a widespread issue. The prevalence of obesity among children and youths is alarming. Novakova, Hamade & Sevcikova (2004) and Wabitsch, Moss & Kromeyer-Hauschild (2014) reported that the increase of prevalence of obesity is slower in the last few years than in past and achieved a plateau level in developed countries. Several authors consider adolescence to be a critical period for the development of obesity and the foundation of lifestyle diseases (Moreno et al, 2008, Moliner-Urdiales et al, 2009, Otteavere et al., 2011). Most studies dealing with the nutritional status are limited

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to mass population surveys based on anthropometric measurements. BMI is the most used epidemiological indicator of obesity, but reflects both body fat and muscle mass (Cova et al. 2017), which gives no indication of distribution of body fat (Bacopoulou, Efthymiou, Landis, Rentoumis & Chrousos, 2015). Other options include circumferential measurements, e.g. waist circumference (WC), waist-to-hip ratio (WHR) or waist-to-height ratio (WHtR), which are associated with abdominal obesity. Savva et al. (2000), Bacopoulou et al. (2015) reported that WC and WHtR are better predictors for risk factors of cardiovascular disease in children and adolescents than BMI. Furthermore, there are direct and indirect methods of assessing body composition indicators; mostly in the two-component model, we distinguish between body fat and fat free mass. Body composition measurements in children are inherently challenging, because of the rapid growth-related changes in height, weight, fat-free mass (FFM) and fat mass (FM), but they are fundamental for the quality of the clinical follow-up (Kyle, Earthman, Pichard & Coss-Bu, 2015). Body composition could be easily studied by Bioelectrical Impedance Analysis (BIA), a non-invasive, low-cost, portable method based on the analysis of bioelectrical impedance in the human body at the passage of a low intensity alternating electrical current (Cova et al., 2017).

However, little is known regarding the age- and sex-related pattern of changes in body composition of Slovak children despite that these national data sets take into account eating habits and local genotype (Novakova et al. 2004).

The aim of the presented study was to assess changes in body composition and intersexual differences among children at pre-pubertal and early-pubertal age.

2. Material and methods

The research group consisted of 348 children aged between 6.0 and 11.9 years (boys n = 212; girls n = 136). Children were included in the research based on their own interest in body composition measurement. A participant's legal guardian received a verbal description of the study procedures before testing, agreed with publishing of the collected data and completed a written informed consent. Due to verification of assumptions, the participants were divided into gender groups and subsequently to the three sub-groups according to calendar age (6.0 – 7.9 years; 8.0 – 9.9 years; 10.0 – 11.9 years). Characteristics of the subgroups and number of participants in each of them are the part of the results section and are presented in Table 1 and 2.

Before analysis of body composition, body height of participants was measured using a portable stadiometer (SECA 217, Hamburg, Germany) with an accuracy of 0.1 cm. Body composition was tested using a direct segmental multi-frequency bioelectric impedance analysis (DSM-BIA). Bioelectrical impedance is a non-invasive, safe, fast and relatively cheap method for body composition analysis at the cellular level (Mala, Maly, Zahalka, & Bunc, 2014). The method is based on measuring resistance and reactance of tissues. Resistance is determined by a tissue's conductivity defined as a ratio of voltage and current. Reactance is defined as a tissue's ability to slow down the current and cause a phase shift. This is an additional resistance that is dependent on the cell membranes' capacity. As claimed by Kyle et al. (2015), recent studies suggest that BIA-derived body composition is valuable to assess nutritional status and growth in children. Bioimpedance was measured using an In Body 230 device (Biospace Co., Ltd.; Seoul, Korea). The device works on the basis of ten repetitions of impedance measurement using two current frequencies, namely 20 and 100 kHz, in each of five body segments (right arm, left arm, trunk, right leg, left leg). According to Karelis, Chamberland, Aubertin-Leheudre & Duval (2013), the In Body 230 device shows high validity of results of directly measurable body composition indicators in comparison to DEXA (r = 0.94 - 0.99), and bioelectric impedance showed excellent reliability with repeated measurements differing by less than 0.20 % with very small 95 % CI (VonHurst, Walsh, Conlon, Ingram, Krug & Stonehouse, 2016). The measurements were processed using Lookin'Body 120 version software (Biospace Co., Ltd.; Seoul, Korea). Body composition was measured using the bioimpedance method under standard conditions described in bioimpedance analysis guidelines (Kyle et al. 2004). Room temperature was kept between 20 and 24 °C to prevent undesirable changes in body water composition (Dittmar, 2003). If possible, the subjects were asked to fast for 2 hours and to urinate or defecate before the measurements.

The following parameters of body composition were monitored: body height (BH), body weight (BW), Body mass index (BMI), percentage of body fat mass (PBF), body fat mass index (BFMI), fat free mass index (FFMI), skeletal muscle mass (SMM), waist to hip ratio (WHR). The FFM and FM indexes are equivalent concepts to the BMI, and are defined as FFM/height^2 and FM/height^2 (Vanltaiie, Yang, Heymsfield, Funk & Boileau, 1990), respectively. WHR, which is calculated based on the waist/hip circumference ratio, is used as an effective indicator of the Body Fat Mass (Heyward & Stolarczyk, 1996). Values of the WHR ratio were obtained from the estimated circumference of waist and hips using measurement on an InBody 230 device.

To describe the collected data, we used the median (ME) and quartile deviation (QD). Supplementary data of basic characteristics also include minimal and maximal values. Normality of data distribution was set using Shapiro-Wilk test (unpublished data). To examine the association between age and selected body composition indicators, Kruskal-Wallis analysis of variance (K-W ANOVA) was used. To determine the significance of the difference among the sub-groups, multiple comparisons for non-normally distributed variables, Mann-Whitney U test with Bonferroni's correction of p-value, were used. Effect size (ES) of age differences was determined using Eta squared values (η2) from a formula for the non-parametric K-W ANOVA test (1): (1) $\eta^2 = [H / (n - 1)]$

Effect size of the observed factor was assessed according to Thomas & Nelson (2001), when $\eta^2 < 0.06$ indicates a small effect, $\eta^2 \geq 0.06$ medium effect and $\eta^2 \geq 0.14$ large effect.

Intersexual differences among the tested groups were also determined using Mann-Whitney U test. Effect size of the factor of gender was evaluated from the results of Pearson's correlation coefficient *r* (Cohen, 1992). The effect size was determined according to Cohen (1988): $r < 0.3$ (small), $0.3 \leq r < 0.5$ (medium), $r \geq 0.5$ (large). The coefficient of effect size was calculated from the following formula: (2) $r = Z/\sqrt{n}$

Statistical significance of differences was assessed with 5 % a 1 % of probability of rejecting the null hypothesis ($p < 0.01$, $p < 0.05$, respectively) for all statistical parameters.

Statistical analysis was carried out using IBM SPSS Statistics, v. 20 (IBM SPSS Inc., Chicago, IL) and Statistica v. 13.1 software (StatSoft, Inc.; Tulsa, USA).

The presented article is the part of VEGA 1/0840/17 project titled „The socio-economic status and the state of infrastructure for physical activities as determinants of primary school students´ physical activity patterns and their physical and motor development".

3. Results and Discussions

Table 1 presents results of the analysis in terms of statistical significance and effect size of differences among girls in various age groups. As indicated by the results, median values of body composition indicators increased along with increasing age of girls.

Based on the results we can state that, among girls in the pre-pubertal period, differences were found in basic somatic indicators of body height and weight and in body composition indicators referring to active body mass, which naturally develops due to maturation of the body.

Significant differences were recorded in BH, BW, SMM, FFMI ($p < 0.01$) when compared using K-W Anova. In the first three indicators, statistical significance of differences was accompanied by the large effect size of the assessed factor of age.

Multiple comparisons using Mann-Whitney U test showed significant differences between all compared age groups. In FFMI, η^2 coefficient achieved the value corresponding to the medium effect size. Also in BMI, significant differences ($p < 0.05$) with medium effect size of age were found in the compared age categories. In these two indicators (FFMI, BMI), multiple comparisons only showed a significant difference between the youngest (SG_1) and the oldest girls (SG_3).

Differences in the monitored indicators of body composition related to inactive mass (PBF, BFMI, WHR) showed neither statistical significance nor effect size ($p > 0.05$, $\eta^2 < 0.06$) despite a slight increase of median values across the age groups.

Table 1. *Results of the statistical analysis of body composition indicators in girls in relation to age differences (Kruskal-Wallis Anova)*

Variables		*ME*	*QD*	Min / Max	K-W Anova	Multiple comparison
BH (cm)	SG_1	123.7	4.4	110.5 / 139.7		SG_1 vs. SG_2 ($p < 0.01$)
	SG_2	135.1	3.9	120.1 / 152.1	85.409 $*^a$	SG_2 vs. SG_3 ($p < 0.01$)
	SG_3	145.8	4.6	135.2 / 160.5		SG_1 vs. SG_3 ($p < 0.01$)
BW (kg)	SG_1	24.6	3.6	17.7 / 43.8		SG_1 vs. SG_2 ($p < 0.01$)
	SG_2	30.0	4.5	21.3 / 52.8	51.825 $*^a$	SG_2 vs. SG_3 ($p < 0.05$)
	SG_3	37.9	8.4	27.2 / 59.7		SG_1 vs. SG_3 ($p < 0.01$)
BMI ($kg.m^{-2}$)	SG_1	16.0	1.2	12.2 / 23.8		
	SG_2	16.9	1.7	12.4 / 24.3	8.475 $\dagger^b$	SG_1 vs. SG_3 ($p < 0.05$)
	SG_3	18.2	2.1	12.6 / 23.2		
PBF (%)	SG_1	16.8	4.2	6.7 / 41.4		
	SG_2	19.4	5.4	8.6 / 37.0	4.330 ^{c}	
	SG_3	20.7	6.1	7.1 / 33.5		
BFMI ($kg.m^{-2}$)	SG_1	2.7	0.9	0.82 / 9.8		
	SG_2	3.3	1.2	1.05 / 8.6	5.893 ^{c}	
	SG_3	3.8	1.4	0.88 / 7.5		
FFMI ($kg.m^{-2}$)	SG_1	13.1	0.5	11.4 / 16.4		
	SG_2	13.5	0.7	10.0 / 15.7	12.350 $*^b$	SG_1 vs. SG_3 ($p < 0.01$)
	SG_3	14.2	1.0	11.7 / 16.2		
SMM (kg)	SG_1	9.9	1.2	7.2 / 16.2		SG_1 vs. SG_2 ($p < 0.01$)
	SG_2	12.5	1.5	7.6 / 18.6	69.364 $*^a$	SG_2 vs. SG_3 ($p < 0.01$)
	SG_3	15.5	2.3	11.2 / 22.1		SG_1 vs. SG_3 ($p < 0.01$)
WHR	SG_1	0.74	0.02	0.67 / 0.92		
	SG_2	0.75	0.03	0.68 / 0.88	5.28 ^{c}	
	SG_3	0.77	0.04	0.67 / 0.86		

Note. BH – body height, BW – body weight, BMI - body mass index, PBF – percentage of body fat, BFMI – body fat mass index, FFMI – fat free mass index, SMM - skeletal muscle mass, WHR – waist to hip ratio, SG_1 – sub-group 6.0 – 7.99 years (n = 69); SG_2 – sub-group 8.0 – 9.99 years (n = 96); SG_3 – sub-group 10.0 – 11.99 years (n = 47);* $p < 0.01$, † $p < 0.05$, ^{a} large effect size, ^{b} medium effect size, ^{c} small effect size.

Table 2. *Results of the statistical analysis of body composition indicators in boys in relation to age differences (Kruskal-Wallis Anova)*

Variables		*M*	*SD*	Min / Max	K-W Anova	Multiple comparison
BH (cm)	SG_1	126.9	3.6	112.0 / 138.4		SG_1 vs. SG_2 ($p < 0.01$)
	SG_2	138.9	3.6	125.0 / 160.0	126.349 *[a]	SG_2 vs. SG_3 ($p < 0.01$)
	SG_3	148.2	6.6	120.3 / 161.1		SG_1 vs. SG_3 ($p < 0.01$)
BW (kg)	SG_1	25.5	2.2	18.0 / 43.8		SG_1 vs. SG_2 ($p < 0.01$)
	SG_2	30.9	3.4	20.8 / 57.0	82.280 *[a]	SG_2 vs. SG_3 ($p < 0.01$)
	SG_3	38.1	7.8	22.9 / 61.5		SG_1 vs. SG_3 ($p < 0.01$)
BMI ($kg.m^{-2}$)	SG_1	15.8	1.2	13.0 / 23.7		SG_2 vs. SG_3 ($p < 0.05$)
	SG_2	16.0	1.4	13.2 / 27.3	13.599 *[b]	SG_1 vs. SG_3 ($p < 0.01$)
	SG_3	16.7	1.9	13.6 / 28.0		
PBF (%)	SG_1	12.6	3.7	3.0 / 37.4		
	SG_2	15.6	4.6	4.6 / 40.0	5.352 [c]	
	SG_3	15.4	5.8	4.5 / 44.6		
BFMI ($kg.m^{-2}$)	SG_1	2.0	0.7	0.4 / 8.5		
	SG_2	2.5	1.0	0.6 / 10.5	6.299 †[c]	
	SG_3	2.5	1.3	0.7 / 12.2		
FFMI ($kg.m^{-2}$)	SG_1	13.6	0.6	12.1 / 15.3		SG_2 vs. SG_3 ($p < 0.01$)
	SG_2	13.7	0.6	8.8 / 17.1	21.705 *[b]	SG_1 vs. SG_3 ($p < 0.01$)
	SG_3	14.6	0.8	12.4 / 16.8		
SMM (kg)	SG_1	11.0	0.7	7.8 / 14.8		SG_1 vs. SG_2 ($p < 0.01$)
	SG_2	13.6	1.2	8.9 / 21.8	101.799 *[a]	SG_2 vs. SG_3 ($p < 0.01$)
	SG_3	17.2	2.6	9.5 / 26.3		SG_1 vs. SG_3 ($p < 0.01$)
WHR	SG_1	0.73	0.02	0.67 / 0.87		
	SG_2	0.74	0.03	0.67 / 0.90	9.606* [c]	SG_1 vs. SG_3 ($p < 0.01$)
	SG_3	0.74	0.04	0.67 / 0.92		

Note. BH – body height, BW – body weight, BMI - body mass index, PBF – percentage of body fat, BFMI – body fat mass index, FFMI – fat free mass index, SMM - skeletal muscle mass, WHR – waist to hip ratio, SG_1 – sub-group 6.0 – 7.99 years (n = 50); SG_2 – sub-group 8.0 – 9.99 years (n = 55); SG_3 – sub-group 10.0 – 11.99 years (n = 31);* $p < 0.01$, † $p < 0.05$, [a] large effect size, [b] medium effect size, [c] small effect size.

In the group of boys (Table 2), we recorded a gradual increase of median values in individual indicators, similarly as in the group of girls. Significant differences at the level of $p < 0.01$ and the effect size coefficient η^2 indicating large effect size were found, due to maturation of the body, in basic somatic parameters (BH, BW) and in the body composition indicator referring to skeletal muscle (SMM). In the second parameter assessing active mass, FFMI, and in BMI, we also found significant differences ($p < 0.01$) but with medium effect size. Multiple comparisons of data showed significant differences in relation to age in BH, BW and SMM in all compared pairs. In the case of BMI and FFMI, the difference between SG1 (6.0 – 7.99 y.) and SG2 (8.0 – 9.99 y.) was not significant ($p > 0.05$) but differences in other pairs of compared data were significant. Indicators describing the proportion of fat mass revealed neither statistical difference nor effect size between various age groups ($p > 0.05$, $\eta^2 < 0.06$).

Table 3. *Results of the assessed intersexual differences in body composition indicators (Man-Whitney U test)*

	SG_1	SG_2	SG_3
BH (cm)	* [c]	* [c]	[c]
BW (kg)	[c]	[c]	[c]
BMI ($kg.m^{-2}$)	[c]	[c]	[c]
PBF (%)	* [c]	* [c]	[c]
BFMI ($kg.m^{-2}$)	* [c]	* [c]	[c]
FFMI ($kg.m^{-2}$)	* [c]	[c]	[c]
SMM (kg)	* [c]	* [c]	[c]
WHR	[c]	[c]	[c]

Note. BH – body height, BW – body weight, BMI - body mass index, PBF – percentage of body fat, BFMI – body fat mass index, FFMI – fat free mass index, SMM - skeletal muscle mass, WHR – waist to hip ratio, SG_1 – sub-group of 6.0 – 7.99 years old; SG_2 – sub-group of 8.0 – 9.99 years old; SG_3 – sub-group of 10.0 – 11.99 years old; * $p < 0.01$, † $p < 0.05$, [a] large effect size, [b] medium effect size, [c] small effect size.

Table 3 shows the results of the assessed intersexual differences among participants in individual age categories. In BH and BW parameters, boys achieved higher median values in all age categories. On the contrary, in BMI, higher values were found in girls. The subsequent statistical analysis using Mann-Whitney U test showed significant differences in BH ($p < 0.01$) and only in the two youngest age categories (6.0 – 7.99 y.; 8.0 – 9.99 y.). Concerning parameters identifying the proportion of adipose tissue (PBF, BFMI), significantly higher values were recorded among girls than in boys. However, statistically significant differences were only found in pre-pubertal age groups (SG_1 and SG_2). Conversely, in sub-groups of boys, we found higher median values when assessing parameters of active body mass (FFMI, SMM). In FFMI, gender differences were statistically significant only among children aged between 6.0 – 7.99 years, while in SMM, statistical significance was recorded also among children aged between 8.0 – 9.99 years. Similarly, as in other examined indicators, neither statistically significant intersexual differences, nor effect size were found in the early-pubertal group (SG_3 10.0 – 11.99 y.). Also in the last assessed parameter, WHR, there were no statistically significant changes or effect size found in any of the tested groups of children (Table 3). Despite the statistical significance of gender differences, the effect size of this factor determined using Pearson’s correlation coefficient was only small ($r < 0.3$).

When assessing body composition of any population group, it is appropriate to refer the results to the national reference values. Since such data are absent in Slovakia, we will compare our results with foreign studies.

In terms of somatic indicators of body height and weight, we can state that values across the monitored age categories gradually increased in both groups of boys and girls. Accordingly, BMI values increased, as well. Body height and weight of our research group showed similar values to the group of German population (Plachta-Danielzik et al., 2012) for both sexes. In the case of BMI, we recorded some differences in the group of boys aged between 8 – 11 years when higher values were found in the German boys. BMI values in the groups of girls were comparable (see more in Plachta-Danielzik et al., 2012). As claimed by Weber, Moore, Leonard & Zemel (2013), the use of BMI as a surrogate of adiposity is especially problematic in the paediatric population, because the relative contributions of FM and lean body mass (LBM) to body weight vary by age, sex, pubertal status, and population ancestry.

Concerning the percentage of adipose tissue (PBF), higher values were measured in the group of girls compared to boys in all three age categories. This result is consistent with results by Schwandt, Von Eckardstein & Haas (2012), whose data demonstrate that the median percentage body fat is considerably higher in females than in males. In girls, median values of PBF gradually increased with age, while in boys, it only increased between the 6^{th} and 9^{th} year; then, in the oldest age group we can see its stagnation (or moderate decline in median for PBF). The results of our girls confirm the claim by Schwandt et al. (2012) that in girls, PBF increases continuously at age 3 years through childhood and adolescence to 18 years. On the other hand, the same authors stated that in boys, especially the upper percentile curves steeply increase between age 5 and 11 years. In our study, PBF stagnated or even dropped at age of 10 – 11 years.

The group of tested boys showed a significantly lower percentage of body fat compared to German peers who were measured using BIA method (Plachta-Danielzik et al., 2012). In the German group, median values achieved 18.7 – 20.4 %, while in our sample, the highest recorded median value was 15.6 % in boys aged between 8-9 years. However, the result in the group of girls was different. A marked predominance of PBF compared to the German group was only found in the youngest group aged between 6-7 years. In other two age categories, mean values achieved by Slovak and German girls were comparable (Plachta-Danielzik et al., 2012). Another study (Schwandt et al. 2012), carried out in Germany, where the authors tested school-age children using the calliper method revealed comparable results in the proportion of body fat in boys. Median values in the monitored age categories (6 – 11 years) ranged between 12.25 – 14.37 % with gradual increase associated with participants' increasing age. In the group of girls, the same authors recorded considerably lower values of percentage of adipose tissue (median values between 14.38 – 17.67 % accompanied by increasing age). McCarthy, Cole, Fry, Jebb & Prentice (2006) created PBF reference curve for UK children and adolescents (5 – 18 years) based on the BIA method. In comparison to these reference values, our participants, both boys and girls, achieved significantly lower median values of body fat percentage. The difference between the groups of boys was around 0.5 – 1.0 % and in the case of girls, this difference was much more pronounced, around 2 %. As these authors reported values divided in annual intervals, it is not possible to determine the exact differences.

In studies on body composition, FMI has shown superiority over PBF since PBF is not corrected by height (VanItallie et al., 1990). However, the use of PBF as the gold standard of adiposity is an incomplete solution that does not consider height, body proportions, and LBM (Wells, 2001, 2014). Therefore, evaluation of health risk factors with regard only to PBF may be incorrect. A high value of PBF may be associated either with a high proportion of fat mass or with a low proportion of lean mass, which is the reason of incorrectly assigned individuals to risky groups. Because FMI takes height into account, it reduces the bias associated with PBF (VanItallie et al., 1990). When comparing intersexual differences, we recorded higher values of FMI in girls. This result is consistent with more studies (Nakao & Komiya, 2003; Wells et al., 2012; Xiong He, Zhang & Ni, 2012; Weber et al., 2013).

Compared to the UK population tested using DEXA (Wells et al., 2012), we recorded significantly lower values of FMI in the Slovak children. In the UK children, FMI values gradually increased across the examined age categories and in the group of boys, it ranged from 2.65 kg.m^{-2} for 6 years to 3.52 kg.m^{-2} for 11 years old. Concerning the girls, the tendency was similar and FMI values ranged between 3.54 – 4.68 kg.m^{-2} (6 – 11 years old girls). In contrast to reference data for the US population measured by the DEXA method published by Weber et al. (2013), we can state that the tested Slovak children, both males and females, showed significantly lower FMI values than the US children in the selected age categories. In the case of boys, the reference value corresponding to the 50th percentile (compared to median from our study) amounted to 4.6 – 4.9 kg.m^{-2} in 8 – 11 years old boys, while in girls, this value was even higher, between 5.1 – 6.3 kg.m^{-2}. However, in this comparison, values for SG_1 are absent since Weber et al. (2013) created a reference curve for the age group of 8 – 20 years old population. Moreover, these results could also be distorted due to the composition of the research sample in terms of race (mixed race sample).

In the case of fat-free mass index (FFMI), we can conclude that values, in both boys and girls, gradually increased with increasing age. Moreover, results also indicated differences in median values with respect to gender, while in all three age categories we recorded predominance of FFMI in favour of boys, although these differences were not statistically significant. Wells et al. (2012) determined reference values for the UK children in the given age category, corresponding to median, in the range of 13.27 – 13.71 kg.m^{-2} for boys and 12.35 – 13.56 kg.m^{-2} for girls. These values gradually increased with children's age. In another research based on BIA measurement, Xiong et al. (2012) reported mean values for the compared age category of Chinese boys between 13.24 – 14.13 kg.m^{-2}. In girls, similarly as in our study, the values were lower and ranged between 12.63 – 13.95 kg.m^{-2}. Freedman et al. (2005) reported in the group of US white children living in

New York and aged between 5 – 11 years (without dividing into age categories) FFMI values for boys 14.2 ± 1 $kg.m^{-2}$ and for girls 13.7 ± 1 $kg.m^{-2}$. If compared with results of foreign studies, our findings show that our tested children had higher FFMI values in all age categories.

4. Conclusions

Across the entire age spectrum, there is only very little information about body composition of the Slovak population. In context of the absent national criteria for the assessment of body composition, further research activities shall lead to its creation and verification since national reference data best reflect the status and nature of dietary habits in the given area.

In the pre-pubertal and early-pubertal age period (6.0 – 11 .0 years), differences caused by maturation of the body (differences between age categories) were found in both males and females in basic somatic indicators of body height and weight and body composition indicators referring to active mass. In characteristics of inactive body mass, no remarkable differences were recorded in childhood. In terms of gender differences, they appeared in body height and PBF, BFMI, FFMI and SMM. Intersexual differences are noticeable from the beginning of the monitored period (pre-pubertal age) and they gradually disappear with early-pubertal age.

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