to the existing norms for boys and girls. Physical growth and development of certain parts of the body follow a different curve, reaching its maximum at different time points. Thus, the morphological structure of the body based on the interaction of all of the anthropometric measures, at various stages of development may be different, i.e., some morphological characteristics at different points in time participate with different coefficients in a specific morphological structure of the body. However, the development of specific morphological characteristics is to a significant extent determined also by the individual body composition caused by endogenous and exogenous factors, which, in the same development period, determine individual subject’s physiological age.

Variations of some morphological characteristics, especially those which are under the significant impact of the exogenous factors, in the population of the same chronological age, can be very wide.

Bala (1981) investigated the structure of the morphological characteristics and established two-dimensional morphological space in primary school children, as follows: skeleton dimensionality body volume and subcutaneous fat. Sturm, Strel, & Ambrožić (1995) have dealt with the changes in the latent structure of the 7

INTRODUCTION

Morphological characteristics of the anthropological status of the human beings/children commonly imply the processes of growth and ontogenetic development. Information on children’s growth in height and their body weight is often used as the indicator of the children’s health and nutritional status, as well as the evaluation of their rate of growth and development (Medved et al., 1987; Pavlović, 1999; Božić-Krstić, Račić, & Pavlica, 2003).

Anthropometric measurements for practical purposes provide insight into the acquisition of the objective physical development of the subject and assist the planning of kinesiology transformation and special contribution to the inter-individual anthropometric variables comparison. As growth and development, in addition to genetic factors, are influenced by the living conditions, physical activity, physiological processes, social status (Maksimović, Matić, & Obrađović, 2008; Hraski, & Živičić, 1996; Malina, Boushard, & Bar, 2004; De Privitello, Caput - Jogunica, Gulani, & Bosc, 2007) and other factors, the results of the children’s anthropometric measurements can provide valuable information about the effects of aforementioned factors, by comparing them

ANALYSIS OF DIFFERENCES BETWEEN MORPHOLOGICAL CHARACTERISTICS OF PRESCHOOL CHILDREN IN BELGRADE

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Abstract

The study was conducted on a sample of 100 subjects aged 6 and 7 divided into two homogeneous subsamples: 48 boys and 52 girls. 12 anthropometric measures have been taken. In order to obtain a symmetrical morphological space each hypothetical morphological factor was assigned three anthropometric variables. The research problem has been related to the determination of the quantitative differences in morphological characteristics between the children of different sexes. The results suggest that the morphological space between the half of the subjects is statistically significant (F=5.051; P=0.000) in the whole space, and observed individually in the variables: Shoulder width, Weight, Medium volume of stretched forearms, Abdominal skin fold, Back skin fold and Forearm skin fold, all in favor of boys. Morphological status of children should be observed when monitoring their physical development and planning and programming kinesiology treatment.

Keywords: boys, girls, anthropometric measuring, physical development, physical activity, social status, multivariate analysis of variance.
to 14 year children morphological characteristics. The differences found in all age and gender categories, indicate high volatility of the latent structure of morphological characteristics. Based on the structural analysis of the morphological characteristics, slightly faster and more harmonious tempo of changes was found in boys throughout the period, unlike the girls, since higher structural changes in girls occur at the age of 7 and 8 and 11 and 12. Gender differences in morphological characteristics were observed at the age of 6 and 7 (Martinović, Pelemiš, Branković, & Mitrović, 2012; Sabo, 2002); contrary findings were presented by Bala (2004). A significant impact of the morphological features on the expression of co-ordination in girls, at the age of 6 and 7, was observed (Dzinović-Kojić, Pelemiš, & Mitrović, 2012). Bioelectrical impedance method in the above age group established that boys also differ in body composition in favor of the larger values of total muscle mass, total water, extra cellular fluid and total protein in the body (Martinović, Pelemiš, Branković, Živanović, & Pelemiš, 2013). In terms of body mass index, (BMI) between boys and girls at the age of 5 and 6, significant differences were found in favor of the larger BMI values in girls (Pelemiš, Martinović, Pelemiš, Mitrović, & Mandić, 2014). No statistically significant difference in terms of the semi-annual increment of height between boys and girls was found, but boys and girls differ in height at the age of 3.5, 5 and 6.5 years, when the boys were slightly higher (Bala, Đordić, Popović, & Sabo, 2006). In terms of body weight the differences between boys and girls were found at the pre-school age, when boys had slightly higher body mass values (Božić-Krstić & Pavlica, 2003). No statistically significant differences were found in morphological characteristics between the children living in the city center, in the suburbs, or between the center and the suburbs, it is therefore concluded that the children living in various residential conditions, in different parts of Novi Sad, do not differ (Božić - Krstić, Pavlica, & Rakić, 2005). Following development trends of the morphological characteristics of children aged 4– 11, statistically significant differences were found in different age groups. Those were defined in the six months period in all anthropometric variables within gender frame (Popović, 2008). The greatest acceleration in body height and body weight in Vojvodina (Novi Sad), observed from 1971 to 2001, was most pronounced between 1971 and 1981, in height (1.84 cm) and weight (1.46 kg) of the boys and girls, and between 1981 and 1991, in height of the girls (1.22 cm). Body height and weight of today’s boys compared to children measured in 1991, are less noticeable and even decrease (-0.64 cm, -0.88 kg). No major changes were found in girls (0.05 cm, 0.27 kg). Body height and weight of the preschool boys and girls in a thirty year period, have only slightly been changed. The growth and development of children shows that there has been deterioration in the living conditions (Božić - Krstić et al., 2003).

The aim of the study was to determine statistically significant differences between boys and girls in the morphological characteristics of the preschool children, aged 6 and 7.

**METHODS**

For the purpose of the study empirical and statistical methods were used. The study was transversal, which means that one measuring was conducted on a preschool children sample. The pre- experimental draft was used, that is, The Ex post facto research design.

The study sample was drawn from the population of children, aged 5 and 6, years, from Belgrade (Republic of Serbia), by random sampling (quota sample). Measurement of the morphological characteristics was performed on a sample of 100 subjects, divided into two subsamples: subsample of boys (N=48) and the subsample of girls (N=52) who attended preschools “11 April” in Novi Beograd city area. The collection of the anthropometric measures was carried out in March, 2013.

As a sample of measuring instruments, following anthropometric measures were selected:

I For the evaluation of the skeleton longitudinal dimensionality:

1) Body height,
2) The range of hand and
3) Length of arms.

II To assess transversal skeleton dimensions:

4) Shoulder width,
5) The width of the pelvis and
6) Diameter of the wrist.

III To estimate body volume and mass:

7) Body weight,
8) Mid-upper arm circumference stretched and
9) Average volume stretched forearm.

IV For the assessment of the subcutaneous adipose tissue:

10) Abdominal skinfold,
11) Back skinfold and
12) Upper arm skinfold.

Prior to the research, subjects’ parents were informed of the course of the study and they gave their written consent as per Ethical Principles for Medical Research Involving Human Subjects - Declaration of Helsinki (2013). Then, anthropometric measuring was implemented for children who had produced a letter of consent. Measurement of the morphological characteristics was performed in the school gymnastic hall, otherwise used for Physical Education classes.

When measured, morphological characteristics standards were observed (the IBP standards):

1) The position of the subjects, a) Standard standing (barefoot in their underwear, head to Frankfort horizontal position), b) Standard sitting position.
2) Defined the parameter,
3) Measuring instrument (Anthropometer by Martin, John Bull calliper type, anthropometric centi-
RESULTS AND DISCUSSION

Statistical analysis of data included:

1) Determining the basic descriptive statistics for all variables. Measuring of the central tendency: arithmetic mean (AS); measure of variability: standard deviation (S); measure of forms of distribution: skewness - measure symmetry of distribution (SKEW) and kurtosis – measure of the homogeneity of distribution (KURT).

2) Testing for distribution normality for all variables the Kolmogorov - Smirnov test, was used.

3) In order to establish a statistically significant difference in the overall morphological space, multivariate (MANOVA) analysis of variance was used, and to determine the differences within the space (individual differences), univariate (ANOVA) analyzes of variance was used.

Table 1 presents descriptive statistics and the differences in the univariate and multivariate level in anthropometric variables, for boys and girls of preschool age, at the level of statistical inference $p > 0.01$.

Based on these results, it can be concluded that boys homogeneity was expressed in almost all variables, except for the variable - Abdominal skinfold, as could have been expected for this sample, given that three standard deviations cannot be classified in the mean of the aforementioned variables. It can be concluded that the nutritional status is at similar level of development. The girls also expressed their homogeneity in all variables. For this group of female subjects, in addition to the similar state of nutritional status, the uniform level of body volume has been noted. The measures of distribution forms do not indicate significant differences between the tested variables. Based on the Kolmogorov - Smirnov test it has been found that there is no statistically significant deviation from normal, expected distribution.

Values of the Wilkins multivariate F test indicate a statistically significant difference in the morphologic characteristics. The univariate F test indicates that significant differences manifested in variables: Shoulder width, Weight, Medium volume of stretched forearms, Abdominal skinfold, Back skinfold and Upper arm skinfold variables all in favor of boys.

No significant differences have been found in the longitudinal dimension of the skeleton, which points to the fact that the subjects did not enter a rapid growth phase, which comes a little earlier for girls. It seems that the long tubular bones in the older pre-school children of our sample, are growing at the same rate. Child’s growth in height and increase in body weight as important indicators of the physical growth, do not take place concurrently during this period. The growth of the bone tissue is the best indicator of height growth and takes place at the expense of the long tubular bones and the spine, while the increase in width and the higher levels of body mass are also the consequence of bone tissue influence, environmental impacts, parts of the nervous and muscular systems and the processes of Kinesiology action. This conclusion is supported by the fact the increased shoulders width in boys indicate more developed part of the arms and shoulders. The boys have had a higher average value of the medium scale stretched forearm, which can also be linked to differing needs of boys and girls in this age group, they are dominant in the physical activity and use more natural forms of movement and constantly activate muscles and regions affected by the bones growth and development. This has been stated by Eliakim and Yoram-Beyth (Eliakim, & Yoram - Beyth, 2003). Increased mean values of the body weight and skinfold in boys reveal significant mass and subcutaneous adipose tissue as a whole. Adequate nutrition is essential for the full child potential development and greatly affects the over-obese children development status (Kitsao-Wekulo et al., 2013). Regular bone tissue growth, in particular its length, is proportional to the monitoring of body weight,
volume of the soft tissue, which implies however, a greater amount of muscle, and at least slightly less fatty tissue, not shown in boys, is also proportional to the regular functioning of the entire CNS, better functioning of all the components responsible for children’s motor behavior. This behavior implies conformity of the regulation of movement functioning mechanism, the actual functioning of the energy regulation mechanism, with the solution for motor problems, appropriate for the respective age of children. Prevalence of overweight and subcutaneous fat among children in our country, is one of the two most important reasons for the lack in physical activity of children (hypokiesias), as confirmed by the results. (Jovanović, Nikolovski, Radulović, & Novak, 2010). In contrast to the prevalence of obesity in our country, the prevalence of malnutrition has been indicated in China, which is associated with stunting in children under the age of 5. This phenomenon is now thankfully, a downward trend. The prevalence of malnutrition is close to normal (less than 5%), the prevalence of stunting was 12.6% in 2009 and 12.1% in 2010, in rural areas (Chen, He, Wang, Deng, & Jia, 2011). Very prominent heterogeneity in the sample regarding the anthropometric variables, can be explained by an uneven level of the anthropological characteristics of preschool children development, especially around the age of 6 and 7, which produces wide range of results. This is consistent with some findings (Sabo, 2006; Pelemiš, 2012), but is in contrast with the other ones (Kosinac, & Katić, 1999).

### CONCLUSION

Constant monitoring and evaluation of the morphological characteristics of children should emphasize the important drawbacks related to their health, better understanding of other potential problems, such as inadequate nutrition and a reduced amount of physical activity. This study is meant to draw attention to a need to implement numerous studies focused on the accuracy of children’s diet and regular physical activity for all children, regardless of their morphological status, and to represent only guidelines in the follow-up and in-

Table 1. Descriptive statistics and differences

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>AS</th>
<th>SD</th>
<th>Sk.</th>
<th>Kurt.</th>
<th>p-K-S</th>
<th>f*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body height (mm)</td>
<td>Boys</td>
<td>1237,41</td>
<td>43,24</td>
<td>-0,646</td>
<td>-0,266</td>
<td>0,694</td>
<td>0,129</td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>1235,50</td>
<td>36,15</td>
<td>-1,165</td>
<td>-0,772</td>
<td>0,575</td>
<td></td>
</tr>
<tr>
<td>Arms wingspan (mm)</td>
<td>Boys</td>
<td>1224,05</td>
<td>44,31</td>
<td>-0,941</td>
<td>0,608</td>
<td>0,072</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>1230,46</td>
<td>32,56</td>
<td>-2,54</td>
<td>-0,637</td>
<td>0,871</td>
<td></td>
</tr>
<tr>
<td>Arm length (mm)</td>
<td>Boys</td>
<td>488,50</td>
<td>20,10</td>
<td>-0,215</td>
<td>-0,576</td>
<td>0,918</td>
<td>0,110</td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>514,58</td>
<td>39,66</td>
<td>-1,319</td>
<td>-1,55</td>
<td>0,510</td>
<td></td>
</tr>
<tr>
<td>Shoulder width (mm)</td>
<td>Boys</td>
<td>365,41</td>
<td>22,69</td>
<td>-1,81</td>
<td>-0,899</td>
<td>0,917</td>
<td>0,000</td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>357,73</td>
<td>21,07</td>
<td>-3,84</td>
<td>0,678</td>
<td>0,755</td>
<td></td>
</tr>
<tr>
<td>Width of pelvic (mm)</td>
<td>Boys</td>
<td>365,41</td>
<td>22,69</td>
<td>-1,81</td>
<td>-0,899</td>
<td>0,917</td>
<td>0,000</td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>211,27</td>
<td>8,46</td>
<td>0,395</td>
<td>-0,059</td>
<td>0,787</td>
<td></td>
</tr>
<tr>
<td>Wrist diameter (mm)</td>
<td>Boys</td>
<td>35,36</td>
<td>2,44</td>
<td>0,333</td>
<td>0,039</td>
<td>0,905</td>
<td>0,189</td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>33,27</td>
<td>2,76</td>
<td>-1,06</td>
<td>-0,787</td>
<td>0,665</td>
<td></td>
</tr>
<tr>
<td>Body weight (0,1 kg)</td>
<td>Boys</td>
<td>254,36</td>
<td>31,16</td>
<td>0,811</td>
<td>0,742</td>
<td>0,875</td>
<td>0,001</td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>242,04</td>
<td>20,52</td>
<td>-0,333</td>
<td>-0,872</td>
<td>0,749</td>
<td></td>
</tr>
<tr>
<td>Medium value of stretched</td>
<td>Boys</td>
<td>195,73</td>
<td>21,80</td>
<td>0,835</td>
<td>0,861</td>
<td>0,564</td>
<td>0,047</td>
</tr>
<tr>
<td>upper arm (mm)</td>
<td>Girls</td>
<td>195,69</td>
<td>23,08</td>
<td>0,817</td>
<td>0,082</td>
<td>0,817</td>
<td></td>
</tr>
<tr>
<td>Medium value of stretched</td>
<td>Boys</td>
<td>182,09</td>
<td>12,86</td>
<td>1,012</td>
<td>1,813</td>
<td>0,772</td>
<td>0,010</td>
</tr>
<tr>
<td>forearm (mm)</td>
<td>Girls</td>
<td>186,31</td>
<td>15,21</td>
<td>0,624</td>
<td>-0,217</td>
<td>0,887</td>
<td></td>
</tr>
<tr>
<td>Abdominal skinfold (0,1</td>
<td>Boys</td>
<td>85,86</td>
<td>45,13</td>
<td>1,252</td>
<td>1,414</td>
<td>0,321</td>
<td>0,003</td>
</tr>
<tr>
<td>mm)</td>
<td>Girls</td>
<td>69,38</td>
<td>27,16</td>
<td>0,336</td>
<td>-0,968</td>
<td>0,709</td>
<td></td>
</tr>
<tr>
<td>Back skinfold (0,1 mm)</td>
<td>Boys</td>
<td>62,36</td>
<td>23,18</td>
<td>1,534</td>
<td>2,834</td>
<td>0,259</td>
<td>0,014</td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>58,50</td>
<td>17,47</td>
<td>1,032</td>
<td>0,211</td>
<td>0,412</td>
<td></td>
</tr>
<tr>
<td>Upper arm skinfold (0,1</td>
<td>Boys</td>
<td>96,73</td>
<td>36,94</td>
<td>1,156</td>
<td>0,876</td>
<td>0,544</td>
<td>0,001</td>
</tr>
<tr>
<td>mm)</td>
<td>Girls</td>
<td>78,42</td>
<td>15,41</td>
<td>0,227</td>
<td>-0,073</td>
<td>0,788</td>
<td></td>
</tr>
</tbody>
</table>

Wilks Lambda= 0.582      Df1= 1  Df2=98  F=5,051;  P=0,000

Key: AS – arithmetic mean; SD- standard deviation; Skewness Sk- symmetry distribution measure; Kurt- homogeneous distribution measure; p-K-S - the level of statistical significance of the Kolmogorov - Smirnov test; f* - statistical significance of the univariate f test;


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