Comparative analysis of the anthropological characteristics of children from Vojvodina (Serbia) and Belarus

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Abstract

Objectives. Anthropological traits of a population offer an insight into nutritional and socio-economic conditions of the region. The aim of the study was to compare anthropometric traits and body mass index in children from Vojvodina and Belarus.
Material and methods. The study is a part of a research project entitled "Variability of morpho-functional indicators in the population of Belarus and Vojvodina - The Republic of Serbia. The study was conducted in Vojvodina from 2001 to 2004 and in various areas of Belarus from 2005 to 2007. The total number of subjects in Vojvodina was 5874 (2879 boys and 2968 girls) and in Belarus 4406 (2268 boys and 2138 girls). All subjects were between 7 and 14 years of age. The survey included height, weight, chest circumference, and the body mass index (BMI kg/m^2) in relation to the age and sex.
Results. The results demonstrate that children from Vojvodina have significantly higher height, weight and chest circumference in relation to Belarus children, with an exception of the height values of 12-year-old girls. The average BMI is significantly higher in both boys and girls from Vojvodina, except for 11-year-old girls. The most noticeable differences in the means of weight, chest circumference, and BMI are recorded in 13-year-old subjects of both sexes. As for the height, the greatest variations are observed in 14-year-old boys and 10-year-old girls.
Conclusions. The study points to differences in morphological characteristics, however, the study is cross-sectional and implies that the establishment of individual criteria for assessing the growth is necessary for future.

Keywords: anthropometric traits; body mass index; children; Vojvodina; Belarus.

Introduction

Anthropometric traits provide insight into the growth, development, body constitution and health condition of a population. During their development, in the period of ontogenesis, both genetic and environmental factors have an influence on the traits. Environmental factors can speed up or slow down the growth and development of certain traits, especially at young age.

As living conditions vary, both temporally and spatially, every region is characterized by a specific anthropological status. Anthropological status of a population offers an insight into the nutritional and socio-economic conditions of a region (Milici, 2015: 50). Some investigations emphasize the importance of assessing the dietary habits of the population, especially those of children and youth (Albu and Hodorca, 2014; Milici, 2016), because at this age healthy lifestyle knowledge has great chances to be established as an ally for the entire life (Zugravu, Rada and Nitu, 2009). Bad-living habits contribute to increasing the percentage of overweight children and require that parents and children should be better informed about the effects of an unhealthy diet on children's development (Baciu, 2011; Milici, 2016).

The study of variability in morpho-functional characteristics of the populations of Vojvodina (Serbia) and Belarus is a part of a mutual project with colleagues from Belarus. Vojvodina and Belarus have been characterized by different processes of economic development and changes in living conditions during the last few decades. The growth and development of basic anthropometric traits in children and adolescents have been studied by a number of authors in Serbia (Gavrilović, 1972; Gavrilović et al. 1987; Božić-Krstić, 1986; Božić-Krstić, Pavlica and Rakić, 2004; Pavlović, 1999; Rakić, Božić-Krstić and Pavlica, 2004; Rakić, Božić-Krstić and Pavlica, 2011) and Belarus (Тегако и сар. 2008a; Tegako, Marfina and Hurbo, 2008b; Tegako and Marfina, 2008c; Marfina, 2015).

As the variability in children and adolescents' growth reflects differences in the quality of their surroundings, anthropological results processed comparatively for different populations of the same age category can explain the influence of certain factors on the dynamics of growth and development in children. Comparative regional studies on the physical growth of children and adolescents can detect variability in the period of growth.

Regarding everything stated above, the aim of the present study was to compare anthropometric traits and body mass index in children from Vojvodina and Belarus.

Material and methods

A cross-sectional anthropometric study was conducted in Vojvodina from 2001 to 2004 and in various areas of Belarus from 2005 to 2007. The total number of subjects in Vojvodina was 5874 (2879 boys and 2968 girls) and in Belarus 4406 (2268 boys and 2138 girls). All subjects were between 7 and 14 years of age and for the purpose of this study their decimal age (based on the date of investigation and birth date) was calculated.

The anthropometric study was performed in compliance with the International Biological Programme and included three traits: stature/height (cm), weight (kg) and mid-chest circumference (cm). The stature measurements were performed using the Martin anthropometer, to the nearest 0.1 cm, the weight was measured on an electronic digital scale with an accuracy of up to 0.1 kg and the mid-chest circumference measures were obtained using the steel tape to the nearest 0.1 cm. The body mass index (BMI) was derived from the weight (kg) and height (m^2) ratio.

Statistical data processing was completed by IBM SPSS 20 Statistics and the results are presented as means and standard deviation (SD) values. The Student t-test was applied for determining the differences in the traits and BMI values recorded in two investigations and the BMI percentiles (3rd, 10th, 25th, 50th, 75th, 90th and 97th) were obtained. In all analyses, the statistical significance was set at $p<0.05$.

Results

        Table 1 shows basic statistical parameters of the stature in relation to the gender and age of children from Vojvodina and Belarus.

Table 1. The stature (cm) of children from Vojvodina and Belarus									
	Vojvodina				Belarus				
	N	Mean	SD		N	Mean	SD	t-test	p	Difference
Boys									
7	313	126.17	6.11		359	123.95	5.85	4.785	**	2.22
8	380	130.94	6.68		327	129.48	5.85	3.091	**	1.46
9	366	136.18	6.58		192	134.00	6.91	3.601	**	2.18
10	349	140.33	6.94		218	138.85	5.86	2.716	**	1.48
11	369	147.31	7.23		125	145.07	7.35	2.963	**	2.24
12	355	153.04	8.10		290	150.09	7.23	4.887	**	2.95
13	359	160.53	8.80		471	156.77	8.71	6.121	**	3.76
14	388	167.20	8.72		286	163.09	8.94	5.968	**	4.11
Girls									
7	320	124.82	6.01		329	123.31	5.85	3.244	**	1.51
8	395	129.81	5.89		190	128.53	6.04	2.420	**	1.28
9	343	135.41	6.64		202	133.36	6.21	3.620	**	2.05
10	362	141.81	6.92		199	139.13	6.76	4.447	**	2.68
11	387	147.74	7.60		130	145.67	7.49	2.710	**	2.07
12	387	153.74	7.52		305	152.67	7.18	1.905	ns	1.07
13	402	159.68	6.34		498	157.44	6.95	5.045	**	2.24
14	372	162.49	6.33		285	160.92	6.29	3.172	**	1.57
ns- no statistical difference; *p<0.05; **p<0.01									

        It can be observed (Table 1) that stature generally increases with age in both boys and girls. Greater variability is detected in 11-year-old boys and girls aged 11 and 12 years, in both Vojvodina and Belarus subjects. Except for 12-year-old girls, the children from Vojvodina show significantly higher stature values than Belarussian boys and girls. In boys, the difference in stature increases with age, starting at the age of 10, and reaches the maximum at the age of 14 (4.11cm). In girls, the greatest difference is observable at the age of 10 (2.68cm).
        Table 2 shows in parallel the weight mean values of boys and girls coming from Vojvodina and Belarus.

Table 2. The weight means (kg) in children from Vojvodina and Belarus									
	Vojvodina				Belarus				
	N	Mean	SD		N	Mean	SD	t-test	p	Difference
Boys									
7	313	27.92	5.69		359	24.93	3.98	7.775	**	2.99
8	380	30.31	6.72		327	27.83	5.03	5.598	**	2.48

9	366	33.70	8.02		191	30.79	5.42	5.072	**	2.91
10	349	36.44	8.25		218	33.99	7.01	3.776	**	2.45
11	369	42.02	11.56		125	38.66	8.66	3.424	**	3.36
12	355	46.69	11.01		291	41.31	8.09	7.152	**	5.38
13	359	52.39	11.43		470	45.55	9.49	9.184	**	6.84
14	388	58.43	11.92		284	51.85	11.44	7.235	**	6.58
Girls										
7	320	26.57	5.04		328	24.42	4.31	5.840	**	2.15
8	395	29.14	5.56		190	26.53	4.60	5.997	**	2.61
9	343	32.97	7.20		203	29.47	6.55	5.814	**	3.50
10	362	36.82	8.41		199	32.65	6.71	6.421	**	4.17
11	387	40.62	9.60		131	38.10	10.04	2.515	*	2.52
12	387	46.28	10.45		305	42.16	9.01	5.568	**	4.12
13	402	52.39	10.94		498	46.64	9.62	8.267	**	5.75
14	372	55.69	10.13		285	50.67	8.98	6.716	**	5.02
*p<0.05; **p<0.01										

The analysis of the results presented in the table above points to an increase in weight in boys and girls coming from both Vojvodina and Belarus. A noticeable variability in weight values is particularly observed in children older than 11 years, in both Vojvodina and Belarus. Children from Vojvodina show significantly higher weight values in relation to the children of the same age living in Belarus. The greatest difference is recorded in children aged 13 and 14.

The basic statistical parameters of mid-chest circumference in relation to the gender, age and area of residence are presented in Table 3.

Table 3. The means of mid chest circumference (cm) of children from Vojvodina and Belarus										
	Vojvodina				Belarus					
	N	Mean	SD		N	Mean	SD	t-test	p	Difference
Boys										
7	313	63.74	5.32		346	60.42	3.44	9.391	**	3.32
8	380	65.53	5.66		290	61.65	3.98	10.420	**	3.88
9	366	68.11	6.89		157	64.39	4.54	7.286	**	3.72
10	349	70.11	6.89		184	67.14	6.20	5.066	**	2.97
11	369	73.80	8.46		119	70.36	7.23	4.325	**	3.44
12	355	76.40	7.94		272	72.28	6.54	7.127	**	4.12
13	359	79.66	8.15		452	73.73	6.44	11.266	**	5.93
14	388	83.52	7.74		272	78.46	8.36	7.890	**	5.06
Girls										
7	320	62.33	5.09		311	59.69	4.06	7.209	**	2.64
8	395	63.98	5.36		153	61.22	4.91	5.748	**	2.76
9	343	67.13	6.56		168	62.78	5.18	8.146	**	4.35
10	362	69.87	6.97		179	65.77	6.23	6.926	**	4.10

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	N	Mean	SD		N	Mean	SD	t-test	p	Differences
11	387	72.59	7.41		120	70.44	8.14	2.575	*	2.15
12	387	76.71	7.75		279	74.58	8.34	3.356	**	2.13
13	402	81.01	7.42		465	76.22	7.05	9.702	**	4.79
14	372	83.34	5.80		259	81.65	6.45	3.366	**	1.69
*p<0.05; **p<0.01										

The results in Table 3 show that the mid-chest circumference values increase with age in children from both countries. A greater variability is observed for the ages of 11-14 in boys and for the ages of 11-13 in girls, in both investigations. Children from Vojvodina show significantly higher values of mid-chest circumference, with the greatest difference appearing in 13-year-old boys and girls (5.93cm and 4.79 cm, respectively).

The means of BMI are given in Table 4.

Table 4. The means ofBMI (kg/m^2) in children from Vojvodina and Belarus										
		Vojvodina				Belarus				
	N	Mean	SD		N	Mean	SD	t-test	p	Differences
Boys										
7	313	17.44	2.59		359	16.16	1.72	7.449	**	1.28
8	380	17.54	2.79		327	16.51	2.11	5.592	**	1.03
9	366	18.01	3.18		191	17.06	2.31	4.036	**	0.95
10	349	18.35	3.09		218	17.52	2.68	3.400	**	0.83
11	369	19.16	3.92		125	18.21	2.78	2.939	**	0.95
12	355	19.78	3.60		290	18.23	2.58	6.338	**	1.55
13	359	20.18	3.28		470	18.38	2.53	8.623	**	1.80
14	388	20.77	3.24		284	19.31	2.99	6.041	**	1.46
Girls										
7	320	16.94	2.25		328	15.96	1.86	6.057	**	0.98
8	395	17.20	2.50		190	15.99	2.09	6.156	**	1.21
9	343	17.85	2.90		202	16.47	2.52	5.838	**	1.38
10	362	18.16	3.06		199	16.77	2.50	5.810	**	1.39
11	387	18.45	3.29		130	17.83	3.63	1.723	ns	0.62
12	387	19.45	3.48		305	17.95	2.85	6.224	**	1.50
13	402	20.47	3.72		498	18.71	3.11	7.576	**	1.76
14	372	21.04	3.36		284	19.51	2.94	6.215	**	1.53
ns- no statistical difference; *p<0.05; **p<0.01										

As it is seen in Table 4, boys and girls from Vojvodina have significantly higher BMI values in all the age groups, except for the 11-year-old girls (Table 4).

The percentile values of BMI obtained for boys and girls coming from the two countries are presented in Table 5.

Table 5. Distribution of percentile values of BMI (kg/m^2) in relation to the gender and age of children from Vojvodina and Belarus

	Vojvodina								Belarus						
	3	10	25	50	75	90	97		3	10	25	50	75	90	97
Boys															
7	14.3	14.8	15.7	17.0	18.6	21.0	24.0		13.8	14.4	15.0	15.8	17.1	18.2	20.5
8	14.2	14.8	15.8	16.8	18.7	21.1	24.3		13.6	14.2	15.2	16.2	17.4	19.7	21.6
9	14.1	14.9	15.8	17.3	19.2	22.6	26.5		14.0	14.8	15.7	16.6	18.0	20	21.7
10	14.7	15.3	16.0	17.5	20.1	22.9	24.9		14.6	15.1	15.8	16.8	18.5	20.8	24.0
11	14.9	15.3	16.5	18.2	20.9	24.2	28.2		14.8	15.6	16.2	17.6	19.2	22.4	24.8
12	15.1	15.9	17.2	18.9	21.8	25.0	28.2		14.9	15.6	16.4	17.8	19.5	21.6	24.1
13	15.4	16.8	17.9	19.4	22.0	24.4	27.9		14.9	15.8	16.7	18.0	19.4	21.7	23.9
14	16.1	17.2	18.6	20.2	22.4	25.2	28.8		15.4	16.4	17.4	18.7	20.5	23.1	27.3
Girls															
7	13.6	14.5	15.3	16.6	17.9	20.3	22.4		13.4	14.2	14.7	15.6	16.9	18.4	20.6
8	13.8	14.6	15.4	16.7	18.3	20.6	23.6		13.2	13.8	14.6	15.7	16.8	18.5	21.5
9	14.0	14.9	15.7	17.2	19.3	22.0	25.1		13.4	14	14.8	15.9	17.7	19.4	22.2
10	14.2	15.0	15.9	17.6	19.6	22.5	25.7		13.6	14.3	15.1	16.1	17.8	19.9	23.2
11	14.5	15.2	16.2	17.7	19.7	23.4	26.2		14.3	14.8	15.6	17.0	18.8	21.2	24.4
12	14.9	16.0	17.0	18.5	21.1	24.3	27.9		14.2	15.0	16.1	17.3	19.2	21.1	24.6
13	15.4	16.4	17.9	19.7	22.3	25.8	29.2		14.5	15.4	16.6	18.3	20.2	22.8	25.7
14	16.3	17.5	18.7	20.6	22.8	24.8	29.3		15.2	16.3	17.6	19.1	21.2	23.2	25.6

According to the distribution of BMI percentiles in relation to the gender and age, higher values are observed in subjects of all ages coming from Vojvodina (Table 5).

The value of 50th percentile in 14-year-old boys from Vojvodina equals 20.2 kg/m^2 and in Belarussian boys it is 18.7 kg/m^2, making thus the difference of 1.5 kg/m^2. In girls, the difference is 1.4 kg/m^2 (20.6 and 19.1 kg/m^2 in Vojvodina and Belarus, respectively).

Discussion

The paper presents a comparative analysis of some anthropometric traits of children from Vojvodina and Belarus, focusing on the major anthropometric traits for assessing the body size of an individual or a population. The results suggest that the children from Vojvodina are characterized by higher values of stature (except for the 12-year-old girls), weight, mid-chest circumference and body mass index (with the exception of the 11-year-old girls) in comparison with Belarussian children. The differences can be explained by different genetic and environmental factors, including socio-economic conditions, lifestyle, the degree of physical activity and nutritional habits.

Comparing the obtained results of stature, weight and body mass index with relevant literature data, the children in this study show greater values of the three traits in relation to children from Bahrain (Gharib and Rasheed, 2009) and from Arak-Central Iran (Bayat et al. 2012), but lower than the values reported for children from Cyprus (Savvas et al. 2001). In comparison with children from Bucharest (Radu et al. 2006-2007), Belarussian boys and girls have lower means of stature, weight, and body mass index.

In relation to the data obtained in Western Romania (Emandi et al. 2012), Belarussian boys and girls are characterized by lower stature and weight, and the same is noticed for certain ages groups among children from Vojvodina. The results of this study also suggest that boys and girls from Vojvodina and Belarus show greater stature and weight in comparison with Polish (Niewiadomska et al. 2011) and Turkish (Oner et al. 2004) children, with the exception of the12-year-old Belarussian girls in the latter case.

As a result of entering the period of puberty, the girls analyzed in this study appear to be taller than boys at the ages of 10, 11 and 12, this phenomenon being observed in both countries. The greatest annual increase in boys' stature is noticed at the age of 13, in both Vojvodina and Belarus, which is in line with the data found in the literature (Božić-Krstić, 1986; Emandi et al. 2012). The absolute annual increase of weight and mid-chest circumference is greatest among 14-year-old boys from both Vojvodina and Belarus, while in girls, this is observed at earlier ages.

The data referring to BMI indicates that the values recorded for boys aged 7-9 and girls aged 7-10 in this study are smaller than those reported for children in Greece (Tzotzas et al. 2011). In addition, the 50th percentile of the oldest boys in this study (14 years of age) appears to be lower than in the case of boys from Cyprus (Savvas et al. 2001), Bucharest (Radu et al. 2006-2007) and Western Romania (Emandi et al. 2012).

Conclusion

The boys from Vojvodina, in all the age groups, have higher values for the observed parameters compared to their peers in Belarus. For girls, the same can be generally concluded, except for stature of 12-year-old girls and likewise for weight, mid-chest circumference and BMI of 11-year-old girls.

These differences between subjects from Vojvodina and Belarus can be explained by genetic factors, but also various exogenous factors that influence the growth and development of children in the two observed populations.

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