

## COMPARATIVE ANALYSIS OF PHYSICAL DEVELOPMENT OF CHILDREN, TEEN-AGERS AND YOUTH FROM DIFFERENT COUNTRIES AT THE END OF THE 1990s – THE BEGINNING OF THE 2000s

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### ABSTRACT

We made a comparative analysis of the main indices of physical development of children, teen-agers and youth at the age of 7–17 years from Belarus, Russia, Poland, Serbia, Bulgaria and Estonia, examined in the late 1990s – the early 2000s. The closest tendencies in the growth of Belarusian children of both sexes were noticed with Russians and Poles. Serbian and Estonian children are the tallest. Major variations appear between Belarusian and Estonian schoolchildren. Belarusian young people at the age of 7–17 showed significant similarities with almost all ethno-territorial groups regarding the pace and the nature of growth processes.

*Keywords: main indices of physical development, comparative analysis, Belarusian, Russian, Polish, Bulgarian, Estonian schoolchildren*

### INTRODUCTION

Native and foreign scientists constantly emphasize the importance of studies in the different branches of developmental anthropology. Through decades and from one generation to another, changes in physical development of children and youth, as well as in different territorial and ethnic groups, are the questions of the day.

Studies of the physical development peculiarities of children and youth, held by the team of the Department of Anthropology and Ecology, the Institute of History, the NAS of Belarus from the beginning of 1980 until the beginning

of the 21st century by monitoring growth and development in children, showed the ongoing processes of growth and development acceleration in the rising generations of towns and villages in the 1990s, and demonstrated that urbanization is an important factor, influencing the age of puberty. They also allowed viewing the local character of the growth pattern changes in extreme environmental conditions and exposing different rates of growth processes in the Belarusian school-children of 7–17 years (Salivon et al., 1989; Salivon, 2002; Tegako et al., 2008; Tegako, Marfina, 2008).

The works of Russian scholars allowed to produce a number of theoretical statements in developmental anthropology. They recorded the acceleration beginning in the 1960s, its peak in the middle of the 1970s, the elements of deceleration beginning since the 1980s, and its development in the 1990s. As well, they allowed to estimate the level of somatic development in children and showed the influence of environmental factors on the realization of an individual development program. Russian scholars also pay special attention to interpopulation studies. They give high priority to the comparative analysis of physical development in different age groups of children and youth, examined at certain intervals in the same area, and especially in big urbanized cities (Godina et al., 1999, 2006; Jampol'skaja, 1986, 2003).

Auxological research, held in Poland, is characterized by the comprehensive integrated approach, which is very important for the comparative analysis of morphological traits in children and youth in neighboring countries. Polish scholars analyzed inter-generational variations of biological signs in the process of ontogenesis. That allowed to distinguish more floating signs – the rates of the organism development, the direction of developmental changes, the specific dimensions leading to changes in body proportions. They also showed regularities in physical development of rural schoolchildren. They performed the analysis of physical development indices and pace of sexual maturation in boys and girls, considering the environmental influence (Wolański, 1985; Malinowski, 1987; Wilczewski, 1986, 2005; Wilczewski et al., 2003, *Rozwój fizyczny i sprawność fizyczna*, 2005).

Growth and development, as well as changes of total parameters of physical development in schoolchildren, are continuously controlled in Serbia, Bulgaria and Estonia, where auxological investigations are considered to be the priority anthropological areas, allowing to monitor some health indices (Božić-Krštić et al., 2006; Tineshev, Nikolova, 2008; Lehto, 2004).

## MATERIAL AND METHODS

We analyzed the physical development of Belarusian, Russian, Polish, Serbian, Bulgarian and Estonian children and youth at the age of 7–17 years, examined at the beginning of the 2000s. We also analyzed the annual body length gain (growth rate) in schoolchildren from different countries.

Studies in Belarus were held in different parts of the republic. Total number of the examined was 5,744 persons (2,900 males, and 2,844 females). The total body length and weight were measured according to the standard anthropological method. Mean values and standard deviations were calculated. Statistical significance of differences was defined using the Student t-test.

## RESULTS AND DISCUSSION

Comparison of the mean values of height and weight in children and teenagers of Belarus, Poland, Serbia, Bulgaria and Estonia showed that the height of Belarusian boys in all age groups is shorter than in the children from other countries (Table 1). Variations in height are substantial and approach high reliable values comparing to Polish at 7 – 15 years old (from 1.78 cm,  $p < 0.01$  to 3.69 cm,  $p < 0.001$ ), to Serbian and Estonian at 7–17 years old (from 1.84 cm,  $p < 0.01$  to 5.89 cm,  $p < 0.001$  and from 0.74 cm to 5.58 cm,  $p < 0.001$  accordingly), as well as comparing to Bulgarians at the age of 13 years (3.33 cm,  $p < 0.01$ ). Although during the process of active growth Belarusian children are behind Polish in longitudinal dimensions, these differences disappear after the period of active growth. In most cases the difference was not significant (except 14- and 16-year-old teenagers, when the difference in height was 2.39 cm,  $p < 0.05$  and 1.66 cm,  $p < 0.05$ , respectively).

Females are basically in the same situation. In most cases Belarusian girls are shorter than their Polish mates at 9–11 years (from 2.21 cm to 4.31 cm,  $p < 0.001$ ), shorter than Serbian and Estonian girls at 7–17 years (from 3.12 cm,  $p < 0.05$  to 4.23 cm,  $p < 0.001$ , and from 2.34 cm to 3.70 cm,  $p < 0.001$ , respectively). Similar to boys, Belarusian girls in the period of the second childhood are significantly shorter than Polish girls, but at the age of 17 those differences disappear. Comparing longitudinal dimensions, Bulgarian girls make an exception. Their height is in most ages the same or less than in Belarusian girls – 2.67 cm,  $p < 0.01$  at the age of 12 years. The difference gradually increased with aging to 3.2 cm,  $p < 0.001$  in 17 years. Similar to boys, the minimal difference in the total body length was found between Belarusian and Russian schoolgirls.

**Table 1.** Deviation of height absolute values in children and youth from Russia, Poland, Serbia, Bulgaria and Estonia from those of Belarusian schoolchildren

Age, years	Russia	Poland	Serbia	Bulgaria	Estonia
	Males				
7	+0.11	+2.64****	+3.58****	+1.25	+3.23****
8	+0.27	+0.63	+2.37****	0.18	+3.12****
9	+0.22	+3.11****	+2.79****	+1.30	+4.01****
10	+1.24	+3.69****	+4.77****	+0.65	+4.26****
11	0.26	+0.72	+1.84***	0.77	+3.15****
12	+0.47	+1.78***	+2.43****	+0.11	+4.24****
13	+0.26	+1.89***	+2.16****	+3.33***	+4.38****
14	+2.39*	-+1.18***	+3.29****	+2.01*	+5.58****
15	+1.35	+3.07****	+3.89****	+0.41	+5.16****
16	1,66*	+1,11	+5,89****	+1,19	+4,22****
17	0,83	+0,09	+5,44****	1,74	+0,74****
Females					
7	+1,02	+0,84	+2,36****	+0,39	+3,10****
8	+0,90	+0,06	+2,12****	+0,27	+3,01****
9	+0,13	+3,45****	+4,20****	+1,14	+3,70****
10	0,34	+4,31****	+4,23****	+1,47	+3,65****
11	+0,24	+2,21****	+3,91****	1,77	+3,10****
12	+0,13	0,40	+1,46***	2,67***	+2,64****
13	+0,90	+0,12	+3,29****	+0,26	+3,27****
14	+0,06	+0,46	+2,25****	0,32	+3,24****
15	0,89	+0,17	+0,88***	2,76****	+2,71****
16	+0,76	0,11	+3,12*	3,02****	+3,08****
17	0,07	+0,10	+2,81***	3,20****	+2,34****

Body weight interethnic differences are also significant. In Polish boys comparing to Belarusian ones they are seen at the age of 7–15 years (from 1.41 kg,  $p < 0.005$  to 4.28 kg,  $p < 0.001$ ), in Serbian boys – at the age of 7–17 years (from 1.79,  $p < 0.01$  to 8.01 kg,  $p < 0.001$ ). Estonian boys at 7–15 years also are heavier (from 0.68 kg,  $p < 0.01$  to 4.20 kg,  $p < 0.001$ ) (Table 2).

**Table 2.** The deviation of weight absolute numbers in Belarusian schoolchildren from those of children from other countries

Age, years	Russia	Poland	Serbia	Estonia
	Males			
7	0.02	+1.41*	+2.38****	+0.68***
8	+0.11	0.29	+2.33****	+0.56
9	0.47	+2.05**	+0.80	+0.76
10	+0.26	+0.56	+2.97***	+1.00*
11	1.60	0.71	+1.79***	0.13
12	+0.74	+1.43*	+1.86*	+2.08****
13	+0.79	+2.71****	+3.93***	+3.04****
14	+2.22	+2.99****	+8.01****	+3.58****
15	+2.29	+4.28****	+6.41****	+4.20****
16	+0.61	+1.24	+3.73***	+1.22
17	+0.24	+0.92	+3.89***	+1.64
Females				
7	+0.38	-0.60	+1.96****	+0.45
8	+1.05	-0.04	+2.10****	+0.93****
9	0.06	-2.99****	+2.82****	+1.26****
10	0.79	-1.98****	+3.94****	+1.48****
11	1.14	0.49	-1.73	-0.31
12	-0.79	0.28	-2.39****	-1.66****
13	0.74	-1.99****	-4.58***	-2.85****
14	-0.63	-0.64	-4.27***	-2.99****
15	-0.78	-0.75	-4.73****	-3.18****
16	-0.31	0.13	-3.72***	-2.68***
17	-0.21	-0.64	-2.94***	-1.56

Note: interethnic differences confidence level– \* p < 0.005; \*\* p < 0.02; \*\*\* p < 0.01; \*\*\*\* p < 0.001

Belarusian girls lag in the body mass behind the Polish ones in 9–13 years (1.99–2.99 kg,  $p < 0.001$ ), behind Serbian – in 7–17 years (from 2.94 kg,  $p < 0.01$  to 4.73 kg,  $p < 0.001$ ), and behind Estonian girls in 8–16 years (from 2.28 kg,  $p < 0.01$  to 3.18 kg,  $p < 0.001$ ). Belarusian and Russian children and the youth of both sexes are practically equal in the body weight and the total body length. Similar to the body length, Belarusian males and females lag in the body weight behind other groups, but, when the process of active growth stops, those differences between Polish and Estonian children disappear. This peculiarity of aging, according to the experts' opinion, may reside in the major dependence of the child organism on socio-economic factors in the period of active growth and development. This development period is the most sensible to the unfavorable environmental conditions, which explains the weight deficit in Belarusian children.

Thus, we can say about the growth velocity in children and youth from different countries, that it has its specific nature. Children in Russia at the age of 7 have a “half-growth” spurt, when girls overcome boys in the body height. In the 9-year-old children in Serbia that spurt appears in both the body height and the weight. Authors notice that in most cases that spurt is not seen, but if it happens, it occurs in the minority of children.

The earliest time limits of the first and the second crossing were noticed in the children of Belarus, Poland and Bulgaria (10 and 13 years, 10 and 12 years, and 10 years, accordingly). In the children of Russia, Serbia, Estonia, those time limits were shifted to approximately a year later.

Growth curves of the body weight exhibit that Russian and Polish girls are, in fact, not ahead of boys. The children of Belarus, Serbia and Estonia are more conservative, their body weight curves are characterized by two crossings – in 12 and 13 years.

In connection with a sharp increase of endocrine gland secretory activity, in most countries (Russia, Poland, Serbia, and Estonia) growth acceleration in the adolescent males of 13–15 years is definitely seen. In Belarus and Bulgaria this process begins in the period of the second childhood (12 years). The acceleration of growth is noticed in the period of the second childhood in the girls from Poland and Serbia (at 8–9 years), in Russia (at 10–11 years), and in the children of Belarus and Estonia at the age of 11–12 years. Only in the girls from Bulgaria the acceleration of growth comes in adolescence (12–13 years).

There are some peculiarities in the body length and the weight spurts in boys and girls. Only Belarusian boys had a maximum height gain at 12–13 years, and then, according to the typical biological mechanism of human

ontogenesis, in the next age interval they had a weight spurt. In Russia, Serbia and Estonia, children become taller and gain weight during a year – from 13 to 14 years (maximum in Russia – by 8.45 cm). In Polish boys this process acquired another nature: they have the weight spurt at the age of 13–14 years, and then at the age of 14–15 years they have the maximum body length increase. Similar tendency was noticed in Belarusian girls: at the age of 10–11 years they gained weight, and then at the age of 11–12 years they maximally grew up. The traditional type of development (the body weight spurt follows the height spurt) is seen in the other countries (in Russia and Estonia in a year, in Poland and Serbia in 3 years).

The material analysis showed that the height growth rate in a number of countries steadily decreases with age: in males, generally, at 16–17 years (Belarus, Russia, Serbia, and Bulgaria) and at 15–16 years (Poland, Estonia), in females, mostly, at 14–15 years (Russia, Bulgaria, and Estonia) and at 15–16 years (Belarus, Poland). Serbian girls have the latest terms of growth rate decrease – at the age of 14–15 years.

## CONCLUSIONS

On the whole, the variability analysis of the main physical development parameters in children and youth showed similarities and differences in the examined ethno-territorial groups. Belarusian children of both sexes showed the closest tendencies in the growth dynamics with Russians and Poles, and boys also with Bulgarians. The tallest children are Serbian and Estonian. As is the case with height, Belarusian children of both sexes are similar in the body weight to Russians and Poles as well as to Estonian children. Similar to the body length, the biggest differences are seen between Belarusian and Estonian children. According to the rates and the nature of growth processes, Belarusians of 7–17 years showed considerable similarity to practically all ethno-territorial groups, as maximal growth and weight gain is seen in similar age periods.

It can be assumed that the found differences are caused by environmental rather than genetic factors: by the different level of urbanization in the population sites under study, as well as by social living conditions. Thus, for example, lagging in height and weight of Belarusian schoolchildren from their mates from other countries in the most sexually mature groups could be influenced by more complex ecological and social living conditions, and, consequently, poorer quality of nutrition, stress, etc.

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