

ASSESSMENT OF PHYSICAL DEVELOPMENT HARMONICITY IN SCHOOLCHILDREN FROM THE NEW RUSSIAN TERRITORIES

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Physical development is the most important indicator of the health of children and adolescents, since it enables monitoring thereof. This study aimed to assess the harmonicity of physical development in schoolchildren living in the new territories of the Russian Federation. We used the anthropometric data (body length and weight) of schoolchildren aged 7 to 17 years from the Donetsk People's Republic (DPR; 4004 people) and the Kherson region (2902 people). More than 60% of schoolchildren from the DPR had harmonious physical development, and the least number of harmoniously developed children was observed in the age groups of 11–14 years (58.4% of boys and 56.6% of girls); as for the Kherson region, the physical development was harmonious in more than 50% of schoolchildren therefrom, and lowest number of harmoniously developed children was found in the age groups of 11–14 years (43.1% boys and 45.3% of girls). We identified significant differences in the appearance of the relative risk of disharmonious physical development between boys aged 7–10 and 11–14 years in the DPR and the Kherson region ($\chi^2 = 21.6$, $p < 0.001$ and $\chi^2 = 59.328$, $p < 0.001$, respectively), as well as between girls of the same age groups ($\chi^2 = 14.383$, $p < 0.001$ and $\chi^2 = 11.843$, $p < 0.001$). These relative risk figures indicate that there is a direct link between the territories and the likelihood of disharmonious physical development. The correlation analysis and the calculation of relative risk yielded determination of the critical groups among schoolchildren aged 11–14 in which the number of children developed disharmoniously was the largest.

Keywords: physical development, regional regression scales, new Russian territories, schoolchildren

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Compliance with ethical standards: the study was approved by the local Ethics Committee of the Pirogov Russian National Research Medical University (Minutes No. 239 of 15 April 2024) and conducted in accordance with generally accepted scientific principles of the Declaration of Helsinki (revision of 2013).

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ОЦЕНКА ГАРМОНИЧНОСТИ ФИЗИЧЕСКОГО РАЗВИТИЯ ШКОЛЬНИКОВ НОВЫХ РОССИЙСКИХ ТЕРРИТОРИЙ

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Важнейшим показателем здоровья детей и подростков является физическое развитие — «инструмент контроля за состоянием здоровья ребенка». Целью исследования было изучить гармоничность физического развития школьников новых территорий Российской Федерации. В исследовании были использованы антропометрические данные (длина и масса тела) школьников в возрасте от 7 до 17 лет Донецкой Народной Республики (4004 чел.) и Херсонской области (2902 чел.). Более 60% школьников ДНР имели гармоничное физическое развитие, при этом наименьшее число гармонично развитых детей наблюдалось в возрастных группах 11–14 лет (58,4% мальчиков и 56,6% девочек); более 50% школьников Херсонской области имели гармоничное физическое развитие, при этом наименьшее число гармонично развитых детей выявлено в возрастных группах 11–14 лет (43,1% мальчиков и 45,3% девочек). Выявлены значимые различия в формировании относительного риска дисгармоничного физического развития между мальчиками 7–10 и 11–14 лет в ДНР и Херсонской области ($\chi^2 = 21,6$, $p < 0,001$ и $\chi^2 = 59,328$, $p < 0,001$ соответственно), а также между девочками в тех же возрастных группах ($\chi^2 = 14,383$, $p < 0,001$ и $\chi^2 = 11,843$, $p < 0,001$). Показатели относительного риска школьников ДНР и Херсонской области свидетельствуют о наличии прямой связи между территориями и вероятностью дисгармоничного физического развития. Проведенный корреляционный анализ и расчет относительного риска позволили установить «критические группы» школьников 11–14 лет, в которых наблюдается наибольшее число детей с дисгармоничным физическим развитием.

Ключевые слова: физическое развитие, региональные шкалы регрессии, новые российские территории, школьники

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Physical development, being the child's condition control tool, is one of the most important indicators of the health of children and adolescents [1, 2]. The degree of harmonicity of the physique reflects how well-balanced the processes of growth and development are, and describes the activity of metabolism in the context of the body-environment interaction at any age [1, 2]. The basic figures used in the physical development assessment are the anthropometric data [1, 2]. The assessment itself involves a comparison of these figures with those considered standards at the regional, national, and international levels. Most researchers believe it is best to prioritize regional standards, since they factor in the specifics of the given territory (climatogeographic, ethnic, ecological, socio-economic conditions, etc.) [3, 4].

On September 30, 2022, there were signed international agreements admitting the new regions to the Russian Federation (RF). In this regard, the physical development of children and adolescents there is of interest to both scientists and healthcare professionals [5].

The purpose of this study was to assess the harmonicity of physical development of schoolchildren in the new territories of the Russian Federation.

METHODS

The study relied on the anthropometric data (body length and weight) of schoolchildren aged 7 to 17 years from the Donetsk People's Republic (DPR; 4004 people) and the Kherson region (2902 people). The data were taken from the official medical documentation (preventive medical examination cards for minors, Form No. 030-PO/u-17). The schoolchildren were divided into three age periods: 7–10 years old, 11–14 years old and 15–17 years old, according to the age division practiced in the Russian Federation. The assessment of the physical development of schoolchildren was based on the regional age and sex modified body length-dependent weight regression scales [6, 7]. The study yielded a conclusion describing how harmonious (disharmonious) the physical development of schoolchildren in the new Russian territories is [6, 7].

For statistical processing of the obtained data, we used the Statistica 13 software package (StatSoft; USA) and Excel 2016 (Microsoft; USA). The mathematical analysis of the data involved calculation of the statistical indicators using methods of descriptive statistics. Since the analyzed indicators are attributive and measured on a nominal scale, we represented them as calculated proportions — how often each occurs in the sample — and determined the 95% confidence Wilson score intervals. To analyze the attributive data on a nominal scale, we used the four-field conjugacy tables and calculated the Pearson's chi-square criterion (χ^2), the relative risk (RR), and its 95% confidence interval. The critical significance level for all statistical methods (criteria) used was $p \leq 0.05$.

RESULTS

More than 60% of schoolchildren in the DPR had harmonious physical development; the smallest number of harmoniously developed children was observed in the age group of 11–14 years (58.4% boys and 56.6% girls) (Table).

In the Kherson region, physical development was harmonious in over 50% of schoolchildren; the largest number of disharmonious development cases was registered in the 11–14 years age group (43.1% boys and 45.3% girls).

In DPR, the common reason behind the disharmonious physical development in the 7–10 years age was short stature,

registered in 14.3% of boys and 16.2% of girls; it may indicate a possible delay in biological development. The main reason in the 11–14 years age group was excess body weight, seen in 18.3% of boys and 18.7% of girls. In the 15–17 years age group, disharmonious physical development stemmed from insufficient body weight in boys (25.5%) and excess body weight in girls (15.0%).

In the Kherson region, the key reason for disharmonious physical development in the 7–10 years age group was excess body weight in boys (21.6%) and insufficient body weight in girls (16.3%). In the 11–14 years age group, it was also excess body weight in boys (28.0%) and insufficient body weight in girls (19.7%). As for the 15–17 years age group, the common reason behind disharmonious physical development was excess body weight, found in 20.8% of boys and 15.8% of girls.

Assessing the conjugacy of age groups in DPR and calculating the RR of disharmonious development, we identified significant differences between male schoolchildren aged 7–10 and 11–14 years ($\chi^2 = 9.841$, $p < 0.05$), and schoolchildren aged 11–14 and 15–17 years ($\chi^2 = 6.272$, $p < 0.05$). The RR of disharmonious physical development in boys from DPR belonging to the 11–14 years age group exceeded that in other age groups by 1.3 and 1.2 times, respectively (RR = 1.308 (1.104–1.551) and RR = 1.248 (1.047–1.489)); in girls aged 11–14 years, the RR was also 1.3 times higher than in the 15–17 years age group (RR = 1.423 (1.171–1.722)).

In the Kherson region, we revealed significant gender differences in the degree of disharmonious physical development among schoolchildren aged 11–14 and 15–17 years ($\chi^2 = 13.044$, $p < 0.001$ and $\chi^2 = 16.618$, $p < 0.01$, respectively). The RR in boys and girls aged 11–14 years was 1.2 and 1.4 times higher than in the 15–17 years age group, respectively (RR = 1.248 (1.047–1.489), (RR = 1.403 (1.155–1.706)).

The assessment of RR of disharmonious physical development in the same-age schoolchildren (both boys and girls) from DPR and the Kherson region revealed no significance of gender as a risk factor.

We identified significant differences in the causes of RR of disharmonious physical development between boys aged 7–10 and 11–14 in DPR and the Kherson region ($\chi^2 = 21.6$, $p < 0.001$ and $\chi^2 = 59.328$, $p < 0.001$, respectively), and between girls in similar age groups ($\chi^2 = 14.383$, $p < 0.001$ and $\chi^2 = 11.843$, $p < 0.001$). The RR indicators of schoolchildren in DPR and the Kherson region confirm the direct link between the territories they reside in and the likelihood of disharmonious physical development: in boys aged 7–10 and 11–14 years from the Kherson region, the said likelihood was 1.5 and 1.4 times higher, respectively, than for in their peers from DPR (RR = 1.526 (1.278–1.821) and RR = 1.367 (1.201–1.557)). In the Kherson region, girls aged 7–10 and 11–14 had a 1.4 and 1.3 times higher risk of disharmonious development than girls in DPR, respectively (RR = 1.407 (1.180–1.677) and RR = 1.268 (1.109–1.450)).

DISCUSSION

Stature and body weight are the main anthropometric indicators traditionally used in pediatric practice to assess physical development [1, 2]. Deviations of these parameters from the age standards indicate the need for a more extensive examination, and further on — planning and implementation of preventive and health improvement programs, including those designed specifically for the premises of the educational institution [8].

Table. Physical development indicators, schoolchildren of the Kherson region and DPR

Harmonicity of physical development	Age groups	Kherson region				DPR			
		Boys		Girls		Boys		Girls	
		Number	Share (%) (95% CI)	Number	Share (%) (95% CI)	Number	Share (%) (95% CI)	Number	Share (%) (95% CI)
H(N)PhD	7–10 years	160	51.6 (46.88–53.94)	163	52.2 (46.71–57.73)	310	68.2 (63.86–72.39)	284	66.0 (61.45–70.36)
	11–14 years	205	43.1 (38.74–47.63)	172	45.3 (40.89–50.93)	296	58.4 (54.16–62.71)	304	56.9 (52.69–61.06)
	15–17 years	132	59.7 (53.15–65.98)	124	61.0 (54.23–67.53)	253	68.0 (61.86–71.31)	227	63.2 (58.13–68.05)
DPhD, including	7–10 years	150	48.3 (42.88–53.94)	149	47.7 (42.27–53.29)	144	31.7 (27.61–36.14)	146	34.0 (29.64–38.55)
	11–14 years	269	56.0 (52.37–61.26)	207	54.6 (50.14–60.16)	210	41.5 (37.29–45.84)	230	43.1 (38.94–47.31)
	15–17 years	89	40.3 (34.02–46.85)	79	38.9 (32.47–45.77)	126	33.2 (28.69–38.14)	132	36.8 (31.95–41.87)
BWD	7–10 years	46	14.8 (11.31–19.23)	51	16.3 (12.66–20.85)	29	6.3 (4.48–9.02)	16	10.6 (8.12–13.97)
	11–14 years	59	12.5 (9.79–15.76)	75	19.7 (16.26–24.34)	59	11.6 (9.15–14.75)	75	14.0 (11.35–17.25)
	15–17 years	22	9.9 (6.67–14.61)	18	8.8 (5.68–13.58)	20	25.3 (23.44–28.01)	39	10.8 (8.05–14.51)
EBW	7–10 years	67	21.6 (17.39–26.53)	47	15.0 (12.93–19.78)	23	5.0 (3.40–7.49)	13	3.0 (1.78–5.10)
	11–14 years	132	28.0 (24.06–32.11)	100	18.7 (15.65–22.25)	94	18.3 (15.43–22.2)	100	18.7 (15.65–22.25)
	15–17 years	46	20.8 (16.98–26.64)	57	15.8 (12.46–20.02)	67	18.0 (14.17–21.84)	57	15.0 (12.46–20.02)
SS	7–10 years	22	7.0 (4.73–10.51)	36	11.5 (8.45–15.56)	65	14.3 (11.39–17.84)	70	16.2 (13.09–20.06)
	11–14 years	68	14.4 (11.50–17.83)	41	7.6 (5.71–10.23)	39	7.7 (5.69–10.36)	41	7.6 (5.71–10.23)
	15–17 years	17	7.6 (4.86–11.97)	33	9.1 (6.62–12.63)	20	5.3 (3.44–8.01)	33	9.1 (6.62–12.63)
TS	7–10 years	15	4.8 (2.95–7.83)	15	4.8 (2.93–7.78)	27	5.9 (4.12–8.51)	17	3.9 (2.48–6.24)
	11–14 years	8	1.6 (0.86–3.36)	14	2.6 (1.57–4.35)	18	3.5 (2.22–5.55)	14	2.6 (1.57–4.35)
	15–17 years	4	1.8 (0.71–4.56)	3	0.8 (0.28–2.43)	20	5.3 (3.44–8.01)	3	0.8 (0.28–2.43)

Note: H(N)PhD — harmonious (normal) physical development; DPhD — disharmonious physical development; BWD — body weight deficiency; EBW — excess body weight; SS — short stature; TS — tall stature.

In a population of children, adolescents and youth who grow and develop in favorable conditions, the proportion of children with normal (harmonious) physical development approaches 68% (consistent with the normal distribution law) [9].

Earlier studies that involved schoolchildren from Moscow and Kiev found the share of normally developed people in these populations to be exactly that number [10].

However, in our study, we discovered a fairly large proportion of schoolchildren with disharmonious physical development.

As reported in the scientific literature, 2 to 3 percent of children show a delay in biological development of various origins, regardless of gender. At the same time, the high prevalence of overweight and obesity among minors (about 27.1%) is a matter both Russian and foreign specialists are concerned about [11–16].

We found that 14.3% of boys and 16.2% of girls from the 7–10 years age group (DPR) had a short stature, which may indicate a possible delay in biological development.

Excess body weight was the predominant sign of disharmonious physical development among boys in all age groups from

the Kherson region (21.6, 28.0 and 20.8%, respectively) and in the 11–14 years age groups among boys from DPR (18.3%), as well as among girls of the Kherson region aged 15–17 years (15.8%) and girls from DPR aged 11–14 years and 15–17 years (18.7% and 15.0%, respectively).

Body weight deficiency was less common; we registered it in older boys from DPR (25.3%) and in girls of younger and middle age groups from the Kherson region (16.3 and 19.7%, respectively).

The correlation analysis and calculation of the RR showed that age was a factor in disharmonious physical development in the 11–14 years age group, regardless of gender and territory of residence; this is comparable with the results of other studies, because this is the puberty age, when the entire body undergoes rapid transformation [1, 2]. The greatest risk of disharmonious development occurs at the age of 11–14 years, which is a sensitive period associated with the most active changes in the adolescent's body.

A long-term analysis of the dynamics of physical development of children and adolescents indicates a direct dependence of their health status on environmental and socio-economic

factors present in their territory of residence [17]. This study revealed differences between the studied territories: the indicators of disharmonious physical development of schoolchildren in the Kherson region were higher than those in DPR. At the same time, correlation analysis and RR calculation point to a direct relationship between the specifics of the territories and the likelihood of disharmonious physical development in younger children and those in the medium age groups of the sample.

The current scientific publications lack sufficient information on the level of physical development and health of the child population in the new territories of the Russian Federation. Therefore, further research in this area will help practical healthcare in planning science-based preventive measures.

Thus, it is necessary to continue studying children, adolescents and youth residing in the said regions [18].

CONCLUSIONS

This study investigated level of physical development of schoolchildren in the new Russian territories using regional age-sex modified stature-dependent body weight regression scales. We identified deviations in physical development (short stature, overweight and underweight), and the correlation analysis and calculation of the relative risk defined the "critical groups" of schoolchildren aged 11–14 years that included the largest number of people with disharmonious physical development.

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