VARIABILITY OF SOME PHYSIOMETRIC PARAMETERS OF PRESCHOOL CHILDREN

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ABSTRACT
The application of various and attractive physical activities in the physical education process of preschool children is very important for their physical and motor development, their health, and well-being. The purpose of the study was to investigate the changes in variability of certain physiometric parameters in 6- and 7-year-old boys as a result of the applied physical education experimental program over a one-year school period. Methodology: The study focuses on the changes in the variability of specific physiometric parameters resulting from the application of an experimental program in physical education to boys in the IV age group. The object of the study are the physiometric parameters of preschool children. Methods of scientific research: theoretical analysis, pedagogical experiment, anthropometry, dynamometry, mathematical and statistical methods. The study was conducted with 67 boys from the IV age group, divided into two groups: experimental (EG) and control (CG). Before and after the experiment, several tests were used to measure the resting pulse, chest circumference–respiratory difference, static strength of the right and left hands, and static strength of the lower back. Results: It was found that both studied groups – EG and CG were approximately homogeneous in almost all parameters studied (the variation coefficient – V%- ranges from 16.60% to 29.95%), except for the low back static strength of boys from EG. In the first measurement, the variation coefficient is very high (V = 34.43%), indicating that the group is highly heterogeneous according to this parameter. The lowest variation coefficient is observed in the resting pulse rate in both EG and CG, indicating that they are homogeneous in this parameter. Conclusion: At the end of the experiment, there was a decrease in the variability of all parameters. In contrast, the resting pulse rate of the EG boys increased slightly, but V% remained within homogeneous values.

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INTRODUCTION

It is scientifically proven that physical development is one of the main criteria for the health status of individuals. It is determined by the interaction of both genetic and environmental factors (Abramova et al., 2020; Shebeko, 2015; Traykova, 2021a).

During that age period, significant structural and functional changes occur in the child's organism, which are heterochronous in nature (Guryev, 2018; Safoshin, 2019; Sotirov, 2020).

Numerous scientific reports point out that engagement in physical activity has numerous benefits for the overall health of human beings. In this regard, the implementation of diverse and attractive physical activities in the physical education process of preschool children is of great importance for their overall development, physical fitness, health, and well-being (Kim, 2015;_Malina, Bouchard, & Bar-Or, 2024; Martínez-Bello & Estevan, 2021; Naydenova et al., 2023; Tomaszewski et al., 2011; Timmons et al., 2007; Stepanenkova, 2005).

For the purpose of our study, we monitored the variability of several physiometric indicators in 6- and 7-year-old boys, as follows: resting heart rate, respiratory difference, hand grip dynamometry of both hands, and standing dynamometry under the influence of an enriched physical education program (Traykova, 2019; Traykova, 2021b).

Resting heart rate is an important indicator of a person's health status and, in particular, of the state of the cardiovascular system. A characteristic feature of preschool children is their higher heart rate compared to that of adults, which depends on several factors: age, gender (Guryev, 2018), physical activity, emotional and health status, day-night dynamics, etc. (Latorre-Roman et al., 2022).

The generally accepted norm for the resting heart rate of preschool-age children is between 80 and 120 beats/min. Guryev (2018) indicates values of 80-90 beats/min for 5-7-year-olds, and according

to Shebeko (2015), this range is wider, 78–99 beats/min, as girls have 5 to 7 beats more than boys. (Guryev, 2018; Shebeko, 2015, etc.). According to data, the normal heart rate in children (5-6 years old) is 75–115 beats/minute (Latorre-Roman et al., 2022).
Respiratory difference is a physiometric indicator that gives an idea of the functional state of the Respiratory system and reflects both the morphological features of the chest and the functional maturity of the respiratory muscles (Slanchev, 1998).
Additionally, its state may be a sign of certain respiratory system diseases, spinal deformities, or neuromuscular imbalances. Its values may vary depending on the child's gender, physical activity, and health status.
A characteristic peculiarity of children's age-related development is the natural increase in their muscle strength (Keneman & Khukhlaeva, 1985).
Hand grip strength is commonly used as an indicator of overall muscle strength in medical and sports practices. According to Keneman and Khukhlaeva (1985), in preschool age, the strength of the wrist muscles increases from 3.5-4.0 kg at 3-4 year olds to 13-15 kg at 7 year olds, with gender differences in favor of boys. Additionally, the strength of the back muscles increases almost twice by that age, from 15-17 kg at 3-4 years of age to 32-34 kg in children at 7 years of age (Jaksic et al., 2020; Keneman & Khukhlaeva, 1985).
It is scientifically proven that regular physical activity between the ages of 6 and 10 leads to a higher physical fitness level, optimizing physical development and its indicators (Lyakh & Zdanevich, 2004).

Aim and Objectives

The purpose of the study was to investigate the changes in variability of certain physiometric parameters in 6- and 7-year-old boys as a result of the applied physical education experimental program over a one-year school period.
Research objectives:
1. To register the changes in the studied physiometric indicators, as a result of the application of a one-year experimental physical activity program (in Physical culture) of 6 -7-year-old boys.
2. To establish the variability of some physiometric indicators of 6-7-year-old boys before and after the one-year experimental period.

METHODOLOGY

The subject of the study is the changes in the variability of certain physiometric indicators resulting from the application of an experimental program in physical education for boys in the IV age group. The study focuses on the physiometric indicators of preschool children's physical development.
The following methods of scientific research were employed: theoretical analysis, pedagogical experiment, anthropometry, dynamometry, pulsometry, and mathematical and statistical methods, including variation analysis.
A total of 67 healthy boys from the IV age group (6-7 years old) from two kindergartens and one school participated in the study. They were divided into an experimental group (EG, $n = 32$) and a control group (CG, $n = 35$). Before and after the experiment, the children were tested on the following indicators: resting heart rate, respiratory difference (the difference between chest circumference at maximum inhalation and maximum exhalation), hand grip strength of the right and left hands, and static back strength (Slanchev, 1998).
Parents voluntarily signed an informed consent form for their children's participation in this study. The applied experimental program (for EG) included enriched and varied educational content in the field of „Physical Culture" for this age group. It was conducted over a total of 93 pedagogical situations, three times a week, with a duration of 30-35 minutes. We included more attractive, diverse, fun, and accessible physical activities for this age group, related to the educational cores for preschoolers: "Natural-applied physical activity", "Sports preparatory physical activities", "Play activity", and "Physical fitness". The CG followed a standard program system for the kindergarten, approved by the Ministry of Education and Science.

RESULTS

Table 1 presents some of the parameters of the variation analysis of the studied indicators for the IV experimental and control groups, respectively.

Table 1. *Variability of some physiometric parameters of 6/7 year-old boys*

Parameters	Grups	Tests	*n*	X min	X max	*R*	*Mean*	*SD*	V%
Heart rate (beats/min)	**EG**	**I test**	32	80	100	20	90.38	5.65	6.25
		II test	32	76	94	18	85.06	5.41	6.36
									p < .001
	CG	**I test**	35	77	103	26	86.54	5.57	6.44
		II test	35	76	96	20	84.86	5.33	6.28
									p < .001
Respiratory difference (cm)	**EG**	**I test**	32	3	7	4	4.81	1.00	20.79
		II test	32	4	9	5	5.88	1.16	19.68
									p < .001
	CG	**I test**	35	3	8	5	4.94	1.21	24.51
		II test	35	6	14	8	5.99	1.23	20.60
									p < .001
Right-hand grip strength (kg)	**EG**	**I test**	32	5	13	8	8.81	2.07	23.50
		II test	32	7	16	9	10.59	2.31	21.83
									p < .001
	CG	**I test**	35	5	14	9	9.63	2.03	21.08
		II test	35	6	14	8	10.29	1.71	16.60
									p < .001
Left-hand grip strength (kg)	**EG**	**I test**	32	5	15	10	9.06	2.24	24.72
		II test	32	7	16	9	10.97	2.26	20.65
									p < .001
	CG	**I test**	35	5	15	10	9.26	1.72	18.57
		II test	35	7	14	7	10.34	1.80	17.39
									p < .001
Static back strength (kg)	**EG**	**I test**	31	2	40	38	22.45	7.73	34.43
		II test	31	16	44	28	27.03	7.08	25.92
									p < .001
	CG	**I test**	35	10	36	26	22.14	6.63	29.95
		II test	35	9	37	28	23.09	6.63	28.74
									p = .01

The average value of the resting heart rate decreased statistically significantly from 90.38 beats/min in the first test to 85.06 beats/min in the second test in the EG of boys (Table 1). In parallel, a negative increase in the coefficient of variation from 6,25% to 6,36% was found, which preserved the homogeneity of the group (Figure 1).

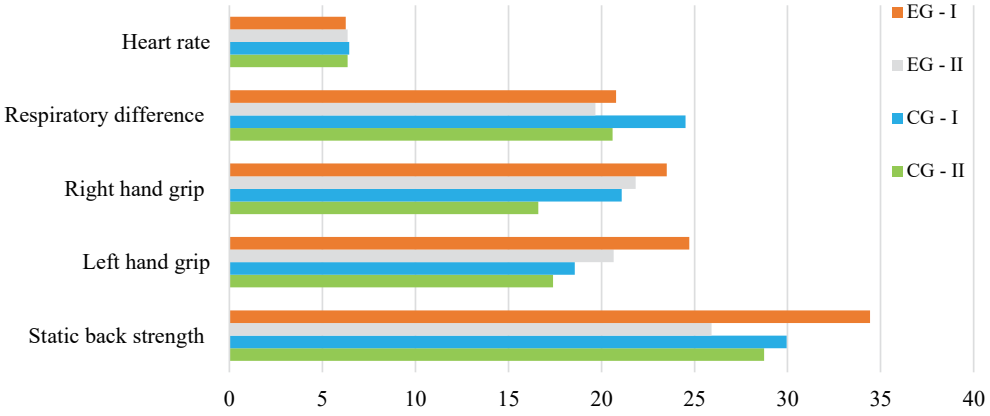

Figure 1. *Changes in the coefficient of variation (V%) of morphofunctional indicators (6/7-year-old boys)*

In the CG, the average level of this indicator also decreased, but to a lesser extent – from 86.54 to 84.86 beats/min, with a statistically significant difference ($p < .001$). The coefficient of variation V% decreased from 6.44% to 6.28%, i.e., the homogeneity within the group at the end of the study is preserved.

The respiratory difference of boys in the EG significantly increased from 4.81 cm to 5.88 cm, and the coefficient of variation decreased from 20.79% to

19.68%, indicating that the group remained relatively homogeneous at the end of the experimental period.

In CG, a similar trend was observed – the average value increased from 4.94 cm at the start of the study to 5.99 cm by the end. The coefficient of variation also decreased – from 24.51% initially to 20.60% later, indicating it became more homogeneous by the end of the experimental period.

The right-hand grip strength of the boys – EG, as measured with the "Hand Dynamometry" test - was significantly increased in average value from 8.81 kg to 10.59 kg. This change is statistically significant ($p < .001$) and is likely related to both the children's natural growth and development and the positive impact of the applied physical activity program. In parallel, a decrease in the coefficient of variation is observed (from 23.50% to 21.83%), indicating an increase in the homogeneity of the group studied.

In CG, a statistically significant difference was registered between the first and second measurement of the same parameter, from 9.63 kg to 10.29 kg, accompanied by a decrease in the coefficient of variation, from 21.08% to 16.60%, which is most likely due to the natural laws of physical growth and development of the children.

The hand grip strength of the left hand in EG shows a statistically significant positive increase in the mean (from 9.06 kg to 10.97 kg), and the coefficient of variation is reduced from 24.72% to 20.65%, indicating that the group became more homogeneous.

The average value of this indicator in the CG increased from 9.26 kg to 10.34 kg, and the coefficient of variation decreased from 18.57% (in the initial test) to 17.39% in the final test, which confirms the comparative homogeneity of the group.

The static back strength of the EG was 22.45 kg in the first test, and in the second test, it increased to 27.03 kg, with a statistically significant difference. The coefficient of variation noticeably decreased from 34.43% to 25.92%. Initially, the group was highly inhomogeneous, but a certain reduction in dispersion was observed at the end, which defines the group as relatively homogeneous.

In the CG group, the mean value between the two tests showed a slight but statistically significant increase, from 22.14 kg to 23.09 kg, and the coefficient of variation decreased slightly from 29.95% to 28.74% (the group remained relatively homogeneous).

DISCUSSION

The analysis of the results shows that, in the morphofunctional indicators measured, a statistically significant increase is recorded, which is most likely due to both biological growth and development, as well as the positive impact of the increased physical activity of the children studied.

Based on the obtained values of the coefficients of variation of the studied groups, it is found that they are approximately homognous in both measurements in almost all the studied indicators (the coefficient of variation V% varies from 16.60% to 29.95%), with the exception of static back strength, where the EG is heterogenous in the first test and in the second one V% determines it as relatively homogenous. The resting heart rate has the lowest coefficient of variation in both the EG and the CG (first and second measurements), which indicates that the groups are homogeneous in this indicator.

The summarized results of the studied physiometric features are consistent with those obtained by other authors investigating the effect of physical activity on morphofunctional indicators in children (Abramova et al., 2020; Jaksic et al., 2020; Traykova, 2019, 2021b).

CONCLUSION

From the data analysis, we can summarize that the observed positive changes in the morphofunctional indicators and the decrease in the variability of individual cases around the mean likely reflect the combined effect of the experimental physical activity program and the natural adaptation processes of the child's organism at that age.

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