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Features of body balance in 12-year-old schoolchildren with visual deprivation compared to their relatively healthy peers

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Abstract

Purpose. The purpose of the presented scientific research was to carry out a comparative analysis of the state of functional balance of the body of 12-year-old schoolchildren with visual deprivation in accordance with their relatively healthy peers.

Material & Methods. The scientific study involved 23 schoolchildren aged 12 years, of which 13 were with visual deprivation and 10 were relatively healthy. The pedagogical research took place at the Educational and Rehabilitation Center “Zorozvit” in Odessa and at the Basic Educational Institution “Vypasnyansky Institution of General Secondary Education” of the

Mologovo Village Council of the Bilhorod-Dnistrovsky District, Odessa Region. The follo wing methods were used in the study: theoretical (analysis and synthesis of scientific and methodological literature); pedagogical research (experiment and testing of the development of body balance using the Flamingo test), mathematical static data processing.

Results. A scientific study found that among schoolchildren without visual deprivation, only 10% had a low ability to maintain body balance. In turn, 90% of schoolchildren with visual deprivation had a sufficient, satisfactory and high level of development of body balance. It should be noted that schoolchildren with visual deprivation demonstrate a low level of ability to maintain balance, which distinguishes them from their peers without visual deprivation.

Key words: visual deprivation, schoolchildren, testing, coordination abilities, body balance.

Introduction

The development of coordination abilities, which indicates the functional state of balance in schoolchildren with visual deprivation, is of great importance for the perception and development of the environment, a harmonious physical and mental state, enrichment of motor experience and maximum socialization (Bukhovets et al., 2024). The search for new approaches to the development of coordination abilities and motor skills of schoolchildren with visual deprivation still remains a relevant topic of scientific research. However, the issues of organizing the process of adaptive physical education for schoolchildren with visual deprivation are debatable. (Walicka-Cuprys et al., 2022).

It has been scientifically proven that the visual analyzer plays the greatest role in the development of a child, since 80% of the perception of the outside world occurs through vision. Problems and diseases of the visual analyzer of varying degrees of manifestation resulting from congenital or acquired anomalies in the development of the organ of vision are accompanied by a decrease in motor activity (Bukhovets et al., 2024). In the future, visual deprivation can cause deviations in the student's physical development, disruption of the psycho-emotional sphere, and a decrease in the indicators of the functional systems of the body *(*Savliuk et al.,2020).

Scientists determine that schoolchildren, as a result of visual impairment, also have reduced motor activity, which negatively affects the formation of such motor qualities as: strength, speed, flexibility and endurance, and especially coordination abilities (general, special, specific), which leads to low level of general physical preparedness (Bukhovets et al., 2024).

Scientists highlight that the development of coordination abilities of schoolchildren with visual deprivation in the process of adaptive physical education must be given enough attention. This is due to the fact

that the student's coordination abilities perform one of the main functions in controlling movements and organize the coordination and ordering of various motor movements into a single whole (Ryadova, 2023). It should be noted that the coordination abilities of schoolchildren with visual deprivation develop most successfully if classes are conducted using various methods and differentiating means in accordance with the ophthalmological diagnosis or a special medical group. Summarizing the data of modern scientific research on the development of coordination abilities has made it possible to establish that the problem of developing coordination abilities of schoolchildren with visual deprivation is relevant and requires attention (Kashuba et al., 2014).

The analysis of scientific research data revealed that the specific features of the development of coordination abilities in children with visual impairments necessitate the development of modern adaptive physical education programs (Kashuba et al., 2017). When comparing the development of coordination abilities of schoolchildren with visual deprivation in comparison with their relatively healthy peers, scientists note significant differences associated with a sedentary lifestyle, pathology of the visual analyzer and the use of outdated approaches in the processes of adaptive physical education (Rashidipour et al., 2021).

Material and methods of research

Study Design

The scientific pedagogical study was carried out with the consent of the parents and in compliance with the basic provisions of the "Rules of moral principles for conducting scientific research involving human subjects" approved by the Declaration of Helsinki (1964–2013).

Subjects

23 12-year-old schoolchildren took part in the research, of which 13 were visually impaired and 10 were relatively healthy. Pedagogical research took place in the Educational and Rehabilitation Center "Zoresvit" in Odesa and in the Support Institution of Education "Vypasnyansky Institution of General Secondary Education" of the Mologiv Village Council of the Bilhorod-Dnistrovsky District of the Odesa Region.

Visual deprivation in the subjects was presented in the form of dysfunction of the visual analyzer of varying degrees of severity. According to the medical documentation, the study subjects were given the following diagnoses: congenital hereditary moderate myopia, converging strabismus, amblyopia, etc. The study used methods such as: theoretical (analysis and synthesis of scientific and methodological literature); pedagogical

research (experiment and testing of the development of coordination abilities) mathematical static data processing.

To study coordination abilities that characterize the state of functional balance of the body, the "Flamingo" test was used (Krutsevych et al., 2011). The results obtained on the scale were compared with test norms, which made it possible to identify the level of functional state of balance in 12-year-old children with visual deprivation and compare the obtained data with their relatively healthy peers. The purpose of the scientific research was to carry out a comparative analysis of the state of functional balance of 12-year-old schoolchildren with visual deprivation in accordance with their relatively healthy peers.

Statistical data analysis

In the process of mathematical processing, the following statistical characteristics were calculated: to describe the primary statistics, the arithmetic mean ($\bar{x}$), standard deviation (S), median (Me) and quartiles of the distribution were calculated, to check the distribution of results for normality - the Kolmogorov-Smirnov (D) and Shapiro-Wilk matching criteria (W); to compare independent samples depending on the nature of the data distribution – Mann-Whitney U test, Student t test. Statistical processing of the research results was carried out using IBM SPSS Statistics 21 software, graphic material prepared in Microsoft Excel. The level of significance of differences was determined by the following critical values:U_{cr}(10; 13; 0,05)=33; t_{cr}(21; 0,01)=2,83; t_{cr}(21; 0,05)=2,08.

Results of the study

Next, we will consider the data of primary statistics of the body balance indicator in 12-year-old schoolchildren with visual deprivation. Thus, the values for it in the group were distributed very tightly. In fact, schoolchildren made 28 or 29 errors per minute with an average value of (28.4 ± 0.51), and this indicates a low level of ability to maintain balance in all adolescents of this age. A comparison of the distributions for the levels of balance of results among 12-year-old schoolchildren with visual deprivation and peers without this pathology shows that the latter have a sufficient level (Figure 1).

As can be seen in Figure 1, among schoolchildren without visual deprivation, only 10% also have a low ability to maintain balance. The rest have mostly sufficient, and some have satisfactory and high levels.

Moreover, this variation belongs to the girls, and the boys all showed sufficient ability to perform balance exercises. Such information allows us to assume a noticeable difference between 12-year-old schoolchildren with and without visual deprivation, as well as possible gender differences. To

conduct a comparative analysis and determine the statistical significance of the identified differences, you first need to determine the parameters of the distribution of the results. This includes calculating the mean, median, standard deviation, and other statistics to help compare data fairly. We can then determine the statistical significance of the differences between the groups and conduct a central tendency analysis.

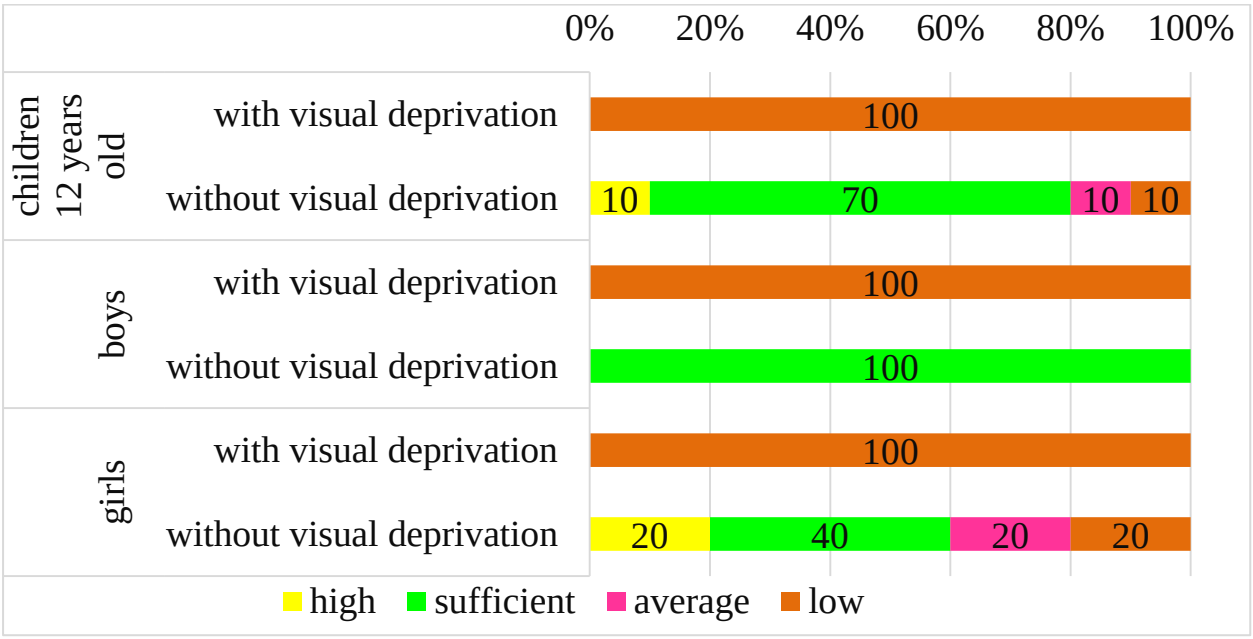

Figure 1. Distribution of data on body balance of 12-year-old schoolchildren with visual deprivation (n=13) and without visual deprivation (n=10) by levels in percentage, where such levels are presented:

To do this, first of all, we will determine whether the distribution of results corresponds to the normal law (Table 1).

The information presented shows that the distribution of the body balance indicator only in the group of girls without visual deprivation meets the criterion of normality. In other groups, the distribution is not consistent with the normal one, hence it is better to use the Mann-Whitney test to assess differences for significance.

Table 1. Results of testing for the normality of the distribution of data on maintaining body balance by 12-year-old children with visual deprivation and their peers without visual deprivation, taking into account gender

Gender	Group by VD	n	Criteria of consistency			
			Kolmogorov - Smirnov with Liliefors' correction		Shapiro - Wilk	
			D	p	W	p
Boys	with VD	8	0,391	p<0,05	0,641	p<0,05
	without VD	5	0,254	p>0,20	0,803	p<0,10
Girls	with VD	5	0,367	p<0,05	0,684	p<0,05
	without VD	5	0,288	p>0,20	0,86	p>0,20
Together	with VD	13	0,392	p<0,05	0,628	p<0,05
	without VD	10	0,227	p>0,10	0,857	p<0,10

Data on the modes and quartiles of distributions in the groups under consideration (Table 2) indicate that 12-year-old adolescents, when performing a balance test, allowed much more loss of the original position than their peers without complications in visual perception. The difference between the number of falls in the general sample was 17 times, and among boys – 17 times. Girls with visual deprivation fell 18 times more often than their peers. In all three cases, statistical testing confirmed that the differences were significant with a high level of confidence. A comparison between adolescents of different sexes showed that adolescents with visual deprivation made approximately the same number of “fouls” per minute, that is, there is no difference between them in their ability to maintain a balanced position. Boys without visual deprivation made 1 more error than girls, but the value of the U-criterion is too high, and therefore such differences will be considered random.

According to the data presented in Table 2, the results indicate that 12-year-old adolescents with visual deprivation demonstrated a worse ability to maintain body balance than their peers without visual deprivation. It should be noted that all those studied with visual deprivation demonstrated a low level of development of coordination abilities, which differs significantly when compared with their relatively healthy peers. This difference becomes especially noticeable when comparing the balance state of schoolchildren with visual deprivation with their peers without visual

pathology, since they more often lost their balance during testing.

Table 2. Differences in the severity of the body balance indicator between 12-year-old adolescents with visual deprivation and without visual deprivation

Group by VD	Statistical indicators	Children 12 years old	Groups by gender		U	p
			boys	girls		
		n=13	n=8	n=5		
with VD	$\bar{x}$	28,4	28,4	28,4	19,5	p>0,05
	s	0,51	0,52	0,55		
	Me	28	28	28		
	25%	28	28	28		
	75%	29	29	29		
		n=10	n=5	n=5		
without VD	$\bar{x}$	11,4	10,6	12,2	12	p>0,05
	s	3,27	1,52	4,49		
	Me	11	11	10		
	25%	9	9	9		
	75%	13	12	16		
Reliability of differences	U	0	0	0	-	-
	p	p<0,01	p<0,01	p≤0,01	-	-

Note. The level of significance of differences was determined by the following critical values: $U_{cr}(10; 13; 0,01)=24$; $U_{cr}(5;8; 0,01)=2$; $U_{cr}(5;5; 0,01)=0$.

Discussion

The presented scientific research presents data that complements a number of modern pedagogical experiments devoted to the analysis of the balance state of schoolchildren with visual deprivation. It is known that the state of physical health of schoolchildren is characterized not only by anthropometric indicators, improvement of vital body systems, but also by the development of basic physical qualities. Coordination abilities are no exception (Kashuba et al., 2017).

Scientists note that the majority of schoolchildren with visual deprivation are able to maintain body balance in given initial positions: standing on two legs, sitting and walking in place (Bukhovets et al., 2024). However, in some cases,

scientists note a fall when changing initial positions and when moving in space. In most cases, this applies to schoolchildren with severe complete or partial visual atrophy (Kashuba et al., 2014). The child's coordination abilities perform an important function in controlling movements, namely coordination, ordering of various motor movements into a single whole in accordance with the task (Rashidipour et al., 2021). Well-developed coordination abilities are a necessary condition for the development of modern adaptive physical education programs for schoolchildren with visual deprivation that require modernization. Scientists note that it is necessary to develop coordination of movements of primary schoolchildren when organizing classes in different forms (Bukhovets et al., 2024).

In adolescence, the development of coordination abilities is improved, as well as the acquisition of knowledge, skills and abilities when performing coordination exercises. Modern scientific studies have noted coordination disorders in relatively healthy schoolchildren. Perhaps we will assume that this trend is due to the sedentary lifestyle of schoolchildren through partial or complete distance learning, the inability to attend sectional classes in their chosen sport, etc. (Ryadova, 2023).

Conclusion

A scientific study found that among schoolchildren without visual deprivation, only 10% had a low ability to maintain body balance. In turn, 90% of schoolchildren with visual deprivation had a sufficient, satisfactory and high level of development of body balance. In a gender comparison of balance development in 12-year-old schoolchildren with visual deprivation, the variation belongs only to girls. The results of a study of the state of balance in children with visual deprivation, who showed sufficient ability to perform physical exercises on balance, are interesting. A comparison between children aged 12 years with visual deprivation did not reveal significant differences in balance.

To summarize these data, we note that all adolescents aged 12 years with visual deprivation demonstrate a low level of ability to maintain body balance, which distinguishes them from their peers without visual impairments. This difference becomes especially noticeable when comparing such students with their peers without visual complications, because they are more likely to lose their balance under test conditions.

Author's contribution

Conceptualization B.B.; methodology B.B.; software B. D.; check O. P.; formal analysis, B. B.; investigation V.B.; re-sources B.B.;

data curation K.V.; writing – rough preparation B.B.; writing – review and editing B.B.; visualization B.D.; supervision O.P.; project administration V.B. All authors have read and agreed with the published version of the manuscript.

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