COMPARATIVE ANALYSIS OF THE STATE OF PHYSICAL FITNESS OF 10-YEAR-OLD CHILDREN WITH VISUAL IMPAIRMENT IN RELATION TO THEIR HEALTHY PEERS AS A PREREQUISITE FOR THE DEVELOPMENT OF CORRECTIVE AND PREVENTIVE MEASURES

ПОРІВНЯЛЬНИЙ АНАЛІЗ СТАНУ ФІЗИЧНОЇ ПІДГОТОВЛЕНОСТІ ДІТЕЙ 10 РОКІВ ІЗ ПОРУШЕННЯМ ЗОРУ СТОСОВНО ЇХНІХ ЗДОРОВИХ ОДНОЛІТКІВ ЯК ПЕРЕДУМОВА ДЛЯ РОЗРОБКИ КОРЕКЦІЙНО-ПРОФІЛАКТИЧНОГО ЗАХОДУ

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DOI https://doi.org/10.32782/2522-1795.2024.18.3.20

Abstracts

According to contemporary scientific research, the state of health in children with visual deprivation can be correlated with the general trend of worsening health among the entire child population. ***The purpose of the study*** – analysis of the state of physical fitness of children of 10 years with vision deprivation and determination of its differences in comparison with their peers. The study was conducted in the ERC "Zoresvit" Odesa, which was attended by 28 children 10-year-old, 14 children with visual deprivation and 14 children without this pathology. ***Research methods:*** theoretical analysis of data from special literature, pedagogical in the form of physical fitness testing, mathematical (central tendency, such as the mean and mode, distribution variability such as standard deviation and quartiles. ***Results of the study.*** The results showed that the values of the speed and dexterity index of children with visual deprivation when performing the shuttle run ranged from 11 to 11.5 s. with an average value equal to 11.2 s. and standard deviation – 0.17 s. (11.2±0.17). The strength indicator for the length of the standing jump varied from 138 cm to 148 cm and was (143.6 ± 3.32) cm on average. The results of the test for lifting the trunk from the initial supine position ranged from 20 to 27 times per minute with an average value of (24.1±2.03) times, and jumping rope for 20 seconds – in the range of 19 to 29 times with an average value of (23.6±3.06) times. The index of flexibility in the inclination of the trunk from the starting position while sitting forward acquired the lowest values, which were equal to 2 cm, and the highest – 8 cm, and the average score was (4.9 ± 1.98) cm. Comparing these results with school norms for performing the corresponding tests allowed to find out that according to none of the indicators, 10-year-old children with visual impairment do not achieve a high level of development of physical qualities and are inferior to their peers. ***Conclusions.*** The search for differences in the indicators of physical fitness of 10-year-old children with visual impairment from their peers without pathology revealed that they were significantly inferior to the latter in performing the proposed tests that require the development of speed, dexterity, endurance and flexibility.

Key words: physical fitness, children, visual deprivation, test.

Згідно із сучасними науковими дослідженнями, стан здоров'я дітей із зоровою депривацією можна співвіднести із загальною тенденцією погіршення здоров'я всього дитячого населення. **Мета дослідження** – аналіз стану фізичної підготовленості дітей 10 років із депривацією зору та визначення його відмінностей порівняно з однолітками. Дослідження проводилося в НРЦ «Зоресвіт» м. Одеса, в якому взяли участь 28 дітей 10 років, 14 дітей із депривацією зору та 14 дітей без цієї патології. Методи дослідження: теоретичний аналіз даних спеціальної літератури, педагогічний (у формі тестування фізичної підготовленості), математичний (центральна тенденція, така як середнє

значення та мода, мінливість розподілу, така як стандартне відхилення та квартилі). **Результати дослідження.** Результати показали, що значення індексу швидкості та спритності під час виконання човникового бігу становили від 11 до 11,5 с, середньоквадратичне відхилення – 11,2±0,17 для довжини стрибка з місця варіювалося від 138 см до 148 см і у середньому становило (143,6 ± 3,32) см. Результати тесту на підйом тулуба з вихідного положення лежачи коливалися від 20 до 27 разів за хвилину у середньому. Значення 24,1±2,03 разів, а стрибки на скакалці за 20 секунд – у діапазоні від 19 до 29 разів із середнім значенням 23,6±3,06 разів. Індекс гнучкості в нахилі тулуба з вихідного положення сидячи вперед набув найнижчих значень, які дорівнювали 2 см, а найвищих – 8 см, а середній бал становив 4,9 ± 1,98 см. Порівняння цих результатів зі шкільними нормативами виконання відповідних тестів дозволило виявити, що за жодним із показників діти 10 років з порушенням зору не досягають високого рівня розвитку фізичних якостей і поступаються своїм одноліткам. **Висновки.** Пошук відмінностей у показниках фізичної підготовленості дітей 10 років з порушенням зору від однолітків без патології виявив, що вони значно поступалися останнім у виконанні запропонованих тестів, які вимагають розвитку швидкості, спритності, витривалості та гнучкості.

Ключові слова: фізична підготовленість, діти, зорова депривація, тестування.

Introduction. According to contemporary scientific research, the state of health in children with visual deprivation can be correlated with the general trend of worsening health among the entire child population. Over recent years in Ukraine, as well as in other countries, there has been an observed tendency towards an increase in the birth rate of children with varying degrees of sensory disorders. In children with visual deprivation, the process of psychophysical development follows the same principles as in typically developing children. However, since children with visual deprivation have sensory system pathology, their psychophysical development path differs from that of their peers without this pathology. This distinctiveness is evident in the rate of physiological growth of somatometric indicators and a low level of physical fitness [1; 5; 7; 12].

In contemporary scientific research, data have been presented indicating that in children with visual deprivation, the level of physical development and physical fitness is significantly lower compared to their peers without visual impairments. Among secondary impairments in children with visual dysfunction, there is weakness in the overall motor musculature and respiratory muscles [2; 4; 7; 13].

Visual impairment in children of various ages primarily complicates spatial orientation, hinders the development of motor skills, and leads to a decrease in both physical and cognitive activity. Children with visual deprivation struggle to maintain a specific body position in space and during movements, most commonly during walking, running, and most natural activities, as well as during physical games. Researchers also note coordination disorders and an inability to execute precision in various movements in this category of children. It is scientifically supported that with age, physical development indicators and levels of physical fitness in children with visual deprivation increase but at a slower rate compared to their peers without this pathology [3; 6; 9; 12].

The age dynamics of physical development in children with visual deprivation are physiological, as in typical development, but the levels can be significantly lower. For example, while in typical development the formation of movement speed is completed by the age of 15, in children with visual deprivation, it continues beyond the age of 16. Schoolchildren with visual impairment experience a delay in static endurance. In typical development, the development of this function is completed by the age of 14, while in children with visual deprivation, it continues to develop until the age of 17 [9]. ***The purpose of the study*** – analysis of the state of physical fitness of children of 10 years with vision deprivation and determination of its differences in comparison with their peers. The hypothesis of the study was that identifying differences in the physical fitness of children with visual deprivation compared to their practically healthy peers would serve as the basis for the development of corrective and preventive measures aimed at improving motor function.

Material & methods. In the study, 28 ten-year-old children participated, including 14 chil-

dren with visual deprivation who were enrolled in the Educational and Rehabilitation Center "Zoresvit" in the city of Odesa, and 14 relatively healthy children who were receiving basic secondary education at the Supportive Educational Institution "Vypasniansky Institution of General Secondary Education" of the Molohivska Village Council in the Bilhorod-Dnistrovskyi District of the Odesa Region. The research was conducted in accordance with the requirements of the Helsinki Declaration of the World Medical Association regarding ethical principles in medical research involving human subjects. The execution of the presented scientific research involved the utilization of a complex of methods, including:

– theoretical analysis: this method encompassed a comprehensive review of specialized literature pertaining to the chosen research topic;

– pedagogical testing: to assess the physical fitness of the children, the study incorporated pedagogical methods in the form of physical fitness testing [10].

The physical fitness level of 10-year-old children, both those with visual deprivation and their relatively healthy peers, was assessed using standardized tests. The following tests were employed:

– strength and muscular endurance: a test involving "lifting the torso from a lying position on the back, with knees bent and fixed, and lowering it to the original position" for 1 minute. The assessment was based on the number of successful attempts per minute;

– speed strength: this test evaluated the ability for quick explosive exertion through a "long jump" test with 2 attempts, and the best result was recorded;

– overall endurance, agility, and speed: a test known as the "shuttle run over 4*9 meters in seconds" was proposed to assess overall endurance, agility, and speed;

– dynamic leg endurance: participants performed a "jump rope for 20 seconds" test to evaluate the development of dynamic leg endurance;

– flexibility and joint mobility: the flexibility and joint mobility of the participants were assessed based on the results of the "forward trunk bend from a sitting position with simultaneous arm extension forward in centimeters" test [10].

The data obtained in this manner were compared with the school norms for the respective tests, taking into account the age of the children. This allowed for an assessment of the level of each indicator relative to the children's age and a comparison between the data obtained from testing children with visual deprivation and their healthy peers [10].

To assess the physical fitness level of the children, the test results were processed using methods of central tendency (such as the mean and mode) and distribution variability (standard deviation and quartiles) [10].

To prepare the data for statistical procedures and select appropriate statistical criteria, the researchers used a procedure to check the normality of the research results. This was done using the Kolmogorov-Smirnov test with Lilliefors and Shapiro-Wilk corrections. To determine differences in physical development, physical fitness, and the functional state of balance between children with visual deprivation and their peers, as well as within this sample, they applied the method of comparing independent samples using the Mann-Whitney and Student's t-tests.

The statistical analysis of the research results was conducted using IBM SPSS Statistics 21 software, and the graphical material was prepared using Microsoft Excel.

Results of the study. The research results indicated that the speed and agility performance of children with visual deprivation during the "shuttle run" test ranged from 11 to 11.5 seconds, with an average value of 11.2 seconds and a standard deviation of 0.17 seconds (11.2±0.17). The long jump from a standing position varied between 138 cm and 148 cm, with an average value of 143.6 cm and a standard deviation of 3.32 cm (143.6±3.32). The results of the sit-up test (number of repetitions per minute) ranged from 20 to 27 repetitions, with an average of 24.1 repetitions and a standard deviation of 2.03 (24.1±2.03). The jump rope test for 20 seconds yielded results ranging from 19 to 29 repetitions,

with an average of 23.6 repetitions and a standard deviation of 3.06 (23.6±3.06). The flexibility test, measured by the forward bend from a seated position, had the lowest values of 2 cm and the highest values of 8 cm, with an average score of 4.9 cm and a standard deviation of 1.98 cm (4.9±1.98).

Comparison of these results with the school norms for the respective tests revealed that none of the 10-year-old children with visual deprivation achieved a high level of physical fitness in any of the indicators (Figure 1).

The data presented in Figure 1 showed that based on the results of the shuttle run, the majority of children (71.4%) demonstrated sufficient development of their ability to perform the maximum number of movements within a certain time frame and the ability to coordinate, perform specific movements simultaneously and sequentially. The results of the remaining participants (28.6%) corresponded to a low level of development of their speed and agility.

After performing the standing long jump, the majority of children with visual deprivation (64.3%) demonstrated a low level of muscular strength and the ability to use it in motor actions, while the rest of the children (35.7%) performed the test at a sufficient level.

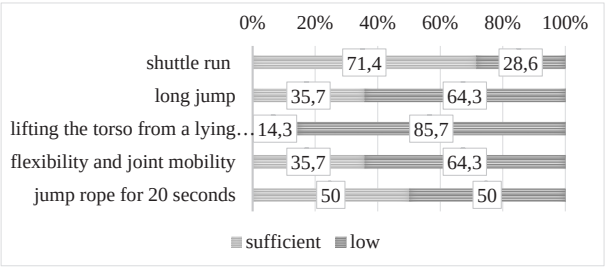

Fig. 1. Distribution of 10-year-old children with visual deprivation based on the results of physical fitness tests in percentages (n = 14), where the following levels are represented

The distribution of results in endurance testing with two test exercises is uneven. For example, in the test of sit-up repetitions within a minute, the majority of children (85.7%) performed at a low level, with only 14.3% achieving a sufficient level of endurance. On the other hand, in the test of jumping rope for 20 seconds, 50% of the participants performed at a sufficient level, while the remaining 50% showed low ability to sustain work at a fixed pace without decreasing productivity. Regarding the forward bend test from a sitting position, 64.3% of the children exhibited a low level of ability to perform joint movements, while 35.7% were able to perform such movements with sufficient amplitude.

Therefore, the majority of 10-year-old children with visual deprivation were characterized by sufficient development of speed and agility, low development of muscle strength and its use in motor actions, weak ability to sustain work for a certain period without a decrease in productivity, and the ability to perform joint movements only with a small amplitude. The examination of the physical fitness test results for 10-year-old children with visual deprivation using normality criteria showed that the distribution of most indicators can be considered suitable for applying parametric analysis criteria (Table 1).

Yes, the distribution pattern of the results approximates normality for indicators of speed and agility (standing long jump), endurance (sit-ups in one minute, and rope skipping for 20 seconds), and flexibility (forward bend from a seated position). However, the strength indicator (standing long jump) exhibits variability that differs from normal distribution. Therefore, for statistical analysis when comparing the research group of children with their peers without visual deprivation, both parametric (such as Student's t) and non-parametric tests (Mann-Whitney U) can be used in specific cases. However, when assessing differences within the group, considering age and gender, it is better to choose the Mann-Whitney U test, as the sample sizes for comparison are small. Let's examine the differences in the means of these indicators between the groups being compared and the data regarding the statistical significance of the obtained differences (Table 2).

The provided information indicates that in the development of physical qualities, children with visual deprivation tend to have a predominance of a low level compared to their peers.

Table 1

Results of the normality test for the distribution of physical fitness data for 10-year-old children with visual deprivation

Indicator	Consistency criteria				
	n	max D	Kolmogorov-Smirnov with Lilliefors correction (p)	Shapiro-Wilk (W)	p
shuttle run	14	0.181	p > 0.20	0.893	0.089
standing long jump	14	0.238	p < 0.05	0.900	0.114
sit-up exercise	14	0.186	p > 0.20	0.933	0.337*
forward trunk flexion from sitting position	14	0.181	p > 0,20	0.924	0.249*
jump rope for 20 seconds	14	0.125	p > 0,20	0.962	0.761*

Notes: n – number of subjects; max D – maximum difference between extrema; p – significance level of distribution differences from normal; * – distribution approximates normal.

Table 2

Differences in the expression of physical fitness indicators between 10-year-old children with visual impairments and their relatively healthy peers

group	n	Statistical Indicators						
		$\bar{x}$	S	Me	25%	75%	U	p
Speed and Agility, Total Endurance (Hopping Race, sec)								
group 1	n=14	11.2	0.17	11.15	11	11.33	48.5	0.022*
group 2	n=14	10.7	0.53	11	10.275	11.175		
Speed Strength (Long Jump, cm)								
group 1	n=14	143.6	3.32	145	140	146	81.5	0.444
group 2	n=14	150.6	12.76	143	140	165.25		
Strength and muscular endurance (trunk lift, times)								
group 1	n=14	24.1	2.03	24.5	22.75	26	3	0**
group 2	n=14	31.9	3.44	33.5	28	35		
Flexibility (forward trunk flexion from sitting position with simultaneous arm extension, cm)								
group 1	n=14	4.9	1.98	4.5	3	7	33.5	0.003**
group 2	n=14	8.0	2.35	7	6	10.25		
Dynamic leg strength endurance (skips with a jump rope in 20 seconds, times)								
group 1	n=14	23.6	3.06	23.5	20.75	26.25	1	0**
group 2	n=14	32.6	2,68	32,5	30	35		

Notes: $\bar{x}$ – mean; S – standard deviation; Me – median of the distribution; 25% – 25th percentile value; 75% – 75th percentile value; U – Mann-Whitney U-test value; p – level of significance for differences; n – number of subjects; gr.1 – children with visual deprivation; gr. 2 – children without visual deprivation; * – statistically significant differences at $p<0.05$; ** – at $p<0.01$.

Discussion. The provided data indicates that children with visual deprivation took, on average, 0.5 seconds longer to complete the exercise on speed and agility compared to their peers without visual deprivation. This difference is statistically significant at the $p<0.05$ level according to the Mann-Whitney criterion (U=48.5) and also at the $p<0.01$ level when using the parametric Student's t-test (t=2.85). Therefore, it is statistically confirmed that 10-year-old adolescents with visual deprivation significantly lag behind their peers in the development of physical qualities such as speed and agility. This supports previous findings that the level of physical fitness in children with visual deprivation is considerably lower than that of their relatively healthy peers [1; 5; 9; 14].

Analyzing the data from the scientific research confirms the assumption that the process of psychophysical development in children with visual deprivation follows the same principles as in children developing typically [7; 12].

While performing the "standing long jump" test, these children demonstrated less power as

they covered a distance that was, on average, 7 cm shorter than their typically developing peers. However, during the statistical analysis, this difference was found to be random, as the value of the Mann-Whitney statistical criterion did not reach the critical threshold (Uкр=55) even at a 5% level of significance. The research findings support the conclusions of several authors regarding the presence of difficulties in maintaining a specific body position in space and executing movements in children with visual deprivation [3; 7].

Teenagers with visual deprivation performed noticeably worse in endurance testing compared to their peers. The difference in the number of successful attempts per minute during the sit-up test averaged 7.8 times less, and it was statistically significant at the level of $p<0.01$ ($U=3$; $t=6.72$). Similarly, the difference in performing jumps with a skipping rope for 20 seconds had an average of 9 repetitions less ($U=1$; $t=8.23$; $p<0.01$). These data highlight a significant lag in the development of the ability of 10-year-old children with visual deprivation to perform work continuously without a decrease in productivity compared to their peers. The experiment confirmed findings regarding the peculiarities of the development of overall motor skills in children with visual deprivation [2; 11; 14].

In terms of flexibility, children with visual deprivation also achieved lower results compared to their peers. The difference in performing the forward sit-and-reach test with simultaneous arm extension was 3.1 cm, and its statistical significance was confirmed at the level of $p<0.01$ ($U=33.5$; $t=3.72$). The data obtained from the observational experiment align with findings from other studies concerning children with visual deprivation, which have confirmed complications in spatial orientation, leading to a reduction in both motor and cognitive activity in general [1; 4; 8].

Conclusions. Therefore, the physical fitness of 10-year-old children with visual impairment, as indicated by the data presented in this scientific study, significantly differed from their healthy peers. They exhibited notably lower levels of speed, agility, endurance, and flexibility compared to the standards for physical education for 10-year-old children. However, their speed and agility were at a sufficient level. In summary, the research on the physical fitness of children with visual impairment demonstrated that, compared to the physical education standards for 10-year-olds, these children had low levels of muscular strength, endurance, and flexibility, but their speed and agility were at an adequate level.

The search for differences in the physical fitness indicators of 10-year-old children with visual impairment compared to similar data obtained from their peers without visual impairments revealed that they performed significantly worse in exercises that required speed and agility, endurance, and flexibility when compared to the latter group. The data obtained in this scientific research can be relevant for the development of correctional and preventive programs as well as physical education and health activities for children with visual impairment in the future. The authors declare that there is no conflict of interest that could be perceived as interfering with publication of the article.

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Прийнято: 12.09.2024
Опубліковано: 31.10.2024
Accepted on: 12.09.2024
Published on: 31.10.2024