

Research article

Improving functional abilities of children with developmental disorders

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Citation: Polevoy G.G. - Improving functional abilities of children with developmental disorders
Balneo and PRM Research Journal
2026, 17(3): 1076

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Received: 28.07.2026
Published: 30.09.2026

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Publisher's Note:
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Abstract: Increasing the physical activity of schoolchildren with mild mental retardation can improve their functional state. The aim of the study was to scientifically substantiate and experimentally verify the effectiveness of an additional lesson in adaptive physical education in a learning disability school to improve the functional abilities of 9-10-year-old children with mental retardation. The study involved 28 schoolchildren with mild mental retardation who studied in the 3rd grade of a learning disability school. The pedagogical experiment was conducted from January 9 to May 30, 2024. Based on the results of the initial testing, 2 homogeneous groups of 14 children were formed. All children studied according to the standard adaptive physical education program for learning disability schools. A third lesson in adaptive physical education per week was introduced in the process of physical education of schoolchildren of the experimental group. The functional state of schoolchildren was determined using 4 standard tests. After the end of the pedagogical experiment, the schoolchildren of the experimental group showed a significant improvement in the indicators for all tests. The Robinson index improved by 12.4% ($P < 0.05$), and the Skibinskaya index increased from 34.8 ± 3.6 to 41.6 ± 3.9 , the increase was 19.5% ($P < 0.05$). According to the Shapovalova index, the average data increased by 13.1% from 246.1 ± 10.4 to 278.4 ± 9.6 ($P < 0.05$), and in the Ruffier index the increase was 16.7% ($P < 0.05$). The results of the study proved the effectiveness of using an additional lesson in adaptive physical education.

Keywords: Learning disability school, Physical education, Lesson, Intellectual disorder, Mental retardation

1. Introduction

Mental retardation is a persistent, severe impairment of cognitive function due to diffuse organic damage to the central nervous system [1,2]. According to the international classification of diseases, mental retardation includes four degrees of intellectual disability: mild, moderate, severe and profound [3].

The category of children with mild mental retardation accounts for 70-80% of the total number. They lag behind their normally developing peers in development, and begin to walk, talk, and master self-care skills later. These children are awkward, physically weak, and often get sick [4]. Children with mild mental retardation are brought up in special kindergartens, and at the age of 7 they enter special schools of the VIII type, where education is conducted according to a special program. Such children have normal concrete thinking, they are able to navigate in practical situations, the emotional-volitional sphere is more intact than the cognitive one, they are well involved in work activities. By the time they graduate from school children with a mild degree of mental retardation differ little in their psychological and clinical manifestations from normally developing people [5].

When mental retardation is moderate, the disorder is detected in the early stages of the child's development. Motor skills are significantly impaired, so self-care skills are formed with difficulty and at a later stage than in normally developing children. School success is limited, they cannot lead an independent life, and need care [6]. Children with severe and profound mental retardation are characterized by the presence of gross defects in perception, memory, thinking, and motor skills, making these children virtually unteachable. They are brought up at home or in special institutions [7].

Children with mental retardation have poor coordination, accuracy and tempo of movements. They are slow, clumsy, which prevents the formation of the mechanism of running, jumping, throwing. Even in adolescence, schoolchildren have difficulty taking and holding a given pose, differentiating their efforts, switching to another type of physical exercise [8]. Delays in the physical development of mentally retarded children, the degree of adaptation to physical activities depend not only on damage to the central nervous system, but are also a consequence of forced hypokinesia. The absence or limitation of motor activities slows down the natural development of the child, causing a chain of negative reactions of the body: resistance to colds and infectious diseases is weakened; prerequisites for the formation of a weak, poorly trained heart are created. Hypokinesia often leads to excess weight, and sometimes to obesity, which further reduces motor activities [9,10]. The level of development of physical qualities is directly dependent on the intellectual defect. Thus, in the development of endurance, children with mild mental retardation are inferior to healthy peers by 11%, with moderate mental retardation – by 27%, with severe – about 40% [11].

The need to correct the deficiencies in the motor sphere of children with developmental disorders, positive impact of this work on the development of the children's psyche have been noted by many researchers [12]. When organizing correctional work with children with various developmental disorders, targeted overcoming of motor deficiencies, development of movements, protection and strengthening of children's health are of great importance [13].

Currently, there are several scientific works devoted to the study of various aspects of motor development of mentally retarded children and the determination of ways to correct developmental deficiencies [14]. The features of motor development of mentally retarded children, features of psychomotor skills of mentally retarded children, ways of developing motor skills in mentally retarded children, general issues of physical education and pedagogical foundations of correcting motor disorders of mentally retarded children in the process of physical education have been studied [1-3,6,9].

Based on these studies, adaptive physical education programs for mentally retarded children of preschool and school age have been developed, and recommendations for their health improvement by means of physical culture have been given [4,8,13].

The process of adaptive physical education is considered a decisive factor in increasing the motor abilities of children with intellectual disorders, correcting motor and physical development disorders, forming motor skills, and as a result - developing personal qualities and cognitive activities of the child [15,16].

Having studied literary sources about children with intellectual disorders, it can be concluded that it is movement that activates the functions of the whole organism, enhances the processes of respiration, blood circulation, improves appetite, and normalizes sleep [17]. Therefore, adaptive physical education is the main means of preventing and strengthening the functional systems of the organism in children with mental retardation. Children with such a diagnosis should not only be helped, but also strive to ensure that they do all the exercises correctly.

Pupils of junior grades of special learning disability schools of the VIII type most often suffer from diseases of the respiratory system (tonsillitis, acute respiratory infections and bronchitis), annually the number of cases is from 53.0 to 71.4%. The second place is taken by diseases of the urinary system (enuresis, cystitis, and pyelonephritis), annually registered in 11.5-12.0% of children [18]. The third place goes to diseases of

the musculoskeletal system (scoliosis and flat feet), which is diagnosed in 10.0-12.0% of children. The fourth place is diseases of the digestive system (chronic gastritis and biliary dyskinesia) - in 6.0-8.0% of children. The fifth and sixth places are taken by eye diseases (astigmatism, myopia, strabismus), which affect 6.2 to 7.0% of children annually, and cardiovascular diseases (most often heart defects) 2.2-2.6% [19].

A wide variety of exercises are used to develop and optimize the functional capabilities of children's bodies, such as general developmental exercises covering all muscle groups, in the initial position lying down, sitting, standing; walking, measured running at a slow pace, jumping, aerobics, swimming, skiing, skating, breathing exercises [20].

Some authors studied the problem of improving the health of students in learning disability school [3,6,8]. The conducted studies prove the low efficiency of modern adaptive physical education programs at school, which do not provide sufficient motor activities for the child. Hence, there is a need for additional classes aimed at increasing the level of functional abilities of students. These classes can be implemented in the process of adaptive physical education.

Physical education at school is the foundation for strengthening health and comprehensive physical development. The importance of physical education lessons is quite great. A lesson at school is obligatory for attendance, it is the most widespread form of classes for schoolchildren, and it is held under the guidance of a teacher and promotes comprehensive physical development [21]. Physical development at school age is very important, since not only physical fitness and health in the future, but also the moral development of the child depend on the timely development of physical skills and abilities [22] is known that a lack of physical activity significantly worsens the health of a growing child and weakens him/her, without physical activity full physical development is impossible [23,24].

In 2010, the Ministry of Physical Culture and Sports of Russia recommended comprehensive schools to introduce an additional third physical education lesson into the weekly volume of the academic load of students. However, in 2021, this recommendation was finally abolished, as educational institutions were unable to cope with a number of problems that arose when implementing the recommendation.

First of all, it is a lack of space for classes, a lack of sports equipment, and personnel problems. Probably, the proposed recommendation did not become obligatory because healthiest children actively participate in sports sections and clubs in addition to physical education lessons at school. But what about children in learning disability schools? To date, not a single school in Kirov has included an additional lesson in adaptive physical education in the curriculum. Thus, our goal was to scientifically substantiate and experimentally test the effectiveness of using an additional lesson in adaptive physical education in a learning disability school to improve the functional abilities of children at the age of 9-10 and who have mental retardation

Research hypothesis. It is assumed that the use of an additional lesson in adaptive physical education at school when working with mentally retarded children will contribute to their more intensive functional development in comparison with children who are engaged in physical education only 2 times a week.

The theoretical significance lies in the theoretical justification of the need for additional motor activities for children with intellectual disorders in learning disability schools who do not receive additional physical activities in addition to the standard two lessons of physical education.

Practical significance is the introduction of the third lesson of adaptive physical education in the process of physical education of children with mental retardation in learning disability schools. This allows significantly improving their functional abilities.

The scientific novelty of the study lies in the introduction of the third lesson of adaptive physical education in the process of physical education of mentally retarded

children aged 9-10 who are not engaged in additional physical activities in order to improve the functional abilities of the body

2. Materials and Methods

The educational experiment was conducted from January 9 to May 30, 2024. All procedures complied with the ethical standards of the Helsinki Declaration and were approved by the local university ethics committee. Informed consent was obtained from each parent. School students could withdraw from the study at any time.

Participants

The study involved 28 children who studied in grades 3a and 3b at the learning disabilities school №13 in Kirov. These were boys and girls aged 9-10 who had a medical diagnosis of mild mental retardation.

Inclusion criteria:

- Boys and girls aged 9-10 years who attend the learning disabilities school №13 in Kirov (Russia).
- Schoolchildren who have a diagnosis of mild mental retardation.
- Children who are regularly engaged in adaptive physical education 2 and 3 times a week.

Exclusion criteria:

- Schoolchildren who did not agree to participate in the experiment.
- Children whose parents did not provide informed consent to participate in the study.
- Boys and girls who, in addition to adaptive physical education lessons at school, had additional physical loads not provided for by the pedagogical experiment.

Intervention

Before the study, all students took control tests. Based on the results of the initial testing, 2 groups were formed in such a way that each group had an equal number of boys and girls, and there were no reliable differences between the groups in all indicators of the control tests.

Thus, the control group consisted of 14 children (6 boys and 8 girls). These students studied according to the program of adaptive physical education lessons for mentally retarded children 2 times a week for 40 minutes (Tuesday and Thursday 10:00-10:40).

The experimental group consisted of 14 children (6 boys and 8 girls). The children studied according to the same program, but an additional weekly lesson of adaptive physical education was included in the curriculum of this group. Thus, schoolchildren from the experimental group did physical education 3 times a week for 40 minutes (Monday, Wednesday and Friday 10:00-10:40).

The content of the 3rd lesson did not involve studying new material; during the lesson, the children consolidated the educational material covered in the previous two lessons. Thus, children in both groups simultaneously mastered the curriculum for adaptive physical education for learning disability schools.

The third weekly physical education lesson was based on the following principles of organizing activities [4,7]:

- 1) an individual approach to each child;
- 2) the principle of age adequacy of pedagogical influences. Correspondence of the selected physical activities to the child's age;
- 3) the principle of variability of pedagogical influences.

When organizing physical exercise classes for children with intellectual disorders, the following methodological recommendations were used [6-8]:

- 1) using various means to prevent the onset of fatigue;
- 2) to use methods that optimally activate the preparatory activity of children;
- 3) to conduct preliminary classes for mastering each section of the program;

4) to encourage children's successes, to develop their faith in their own strengths and abilities.

In the learning disability school, the physical education lesson consists of four parts (introductory, preparatory, main and final).

1. In the learning disability school the introductory part (2-3 minutes) performs the task of organizing children for the lesson, since some students in elementary grades do not yet know how to change clothes and line up on their own. A preliminary conversation with students is held, and students' interest is activated.

2. The preparatory part (5 minutes) prepares the musculoskeletal system and the cardiovascular system to perform the motor tasks that will be offered to students in the main part of the lesson. When working with children with intellectual disorders, special clarity in the sequence of the proposed practical material in the system of preparatory exercises is needed. The preparatory part consists of corrective and general developmental exercises, as well as formations and re-formations, walking, running, jumping. At the end of the preparatory part, exercises that are directly related to the exercises of the main part of the lesson are given.

3. The main part (25-30 minutes) - solving the main tasks of the lesson (correctional and health, general pedagogical and special tasks of physical education). The means for solving are basic gymnastics exercises, rhythmic, corrective, athletics exercises and games. General developmental exercises covering all muscle groups, in the initial position lying, sitting, standing; walking, slow-paced jogging, jumping, aerobics, breathing exercises.

4. The final part of the lesson (3-5 minutes) aims to reduce the overall load on the children's body and summarize the lesson. Relaxation exercises, general developmental exercises, attention exercises, and others are used.

Children with intellectual disorders are easily distracted and tired. They are not motivated by the final goal of the task, and children quickly lose it. To maintain the interest of mentally retarded school students in a physical education lesson, it is recommended [4]:

- 1) to conduct corrective exercises while playing;
- 2) to alternate special corrective exercises with game exercises;
- 3) to introduce elements of competition;
- 4) to use various forms of encouragement;
- 5) to make a preliminary announcement about the upcoming game.

The cardiorespiratory system suffers most in children with intellectual disorders, so the emphasis is on restoring functional performance.

The scientific study included 3 stages of implementation:

1. The preparatory (diagnostic) stage included the analysis of children's medical records with the help of a health worker to determine the characteristics of mental and physical deviations, the study of concomitant disorders and diseases. Medical indications for therapeutic physical training, recommendations for limiting physical activity were studied. Friendly relations with children were established, their preferences and general attitude to physical training were identified.

2. The formative stage began with defining the goal and objectives of the upcoming work. The pedagogical experiment was implemented.

3. The control and analytical stage was carried out jointly with a health worker, the results of the carried out work were analyzed.

An approximate plan of an additional lesson on adaptive physical education in the 3rd grade in the learning disability school looked like this:

Lesson objectives.

Educational:

1. To review of the technique of performing 3x10m shuttle run.

Pedagogic:

1. To foster moral and volitional qualities, discipline.

2. To foster a responsible attitude to classes.

Health-improving:

1. To strengthen the musculoskeletal system.

2. To develop physical qualities.

3. To improve the functional state of the cardiovascular and respiratory systems.

Lesson content.

Introductory part – 2 minutes.

Group lining-up for the lesson. Checking the neatness of the sports uniform. Organized moving to the gym.

Preparatory part – 5 minutes.

1. Lining-up. Announcement of the objectives of the lesson.

2. Turning to the right, left, around. Walking in a column one by one, normally, on tiptoes, in a half-squat. Maintaining correct posture. Normal running and running with a change of direction, switching to walking, changing formation.

Main part – 28 minutes.

1. A set of breathing exercises:

1) “palms” (figure 1). Starting position: stand up straight, bend your arms at the elbows and “show your palms to the teacher”. Take noisy, short breaths through your nose and simultaneously clench your palms into fists. Then exhale slowly.



Figure 1. Palms

2) “pump” (figure 2). Starting position: stand up straight, legs narrower than shoulder width, arms along the body. Bend slightly (reach your arms toward the floor, but do not touch it) and simultaneously take a loud, short breath through your nose. The breath should end with the bend. Raise yourself slightly, but do not straighten up, and bend again and take a short breath. Then exhale slowly.



Figure 2. Pump

3) “hug your shoulders” (figure 3). Starting position: stand up straight, arms bent at the elbows and raised to shoulder level. Throw your arms towards each other until the end, as if hugging yourself by the shoulders. And at the same time, take a sharp breath. Then exhale slowly.

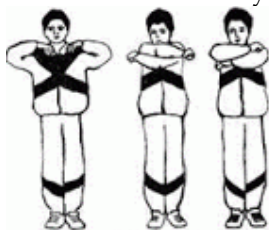


Figure 3. Hug your shoulders

4) “head turns” (figure 4). Starting position: stand up straight, legs narrower than shoulder width apart. Turn your head to the right - take a short breath on the right

side. While turning your head to the other side, exhale slowly. Then take a short breath through your nose on the left side.

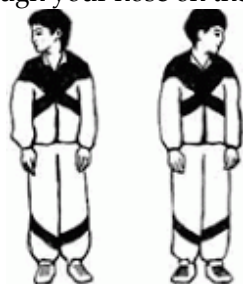


Figure 4. Head turns

5) "head pendulum" (Figure 5). Starting position: stand up straight, feet slightly narrower than shoulder width. Lower your head down, take a sharp, short breath. Raise your head up and inhale again. Exhale after each breath.

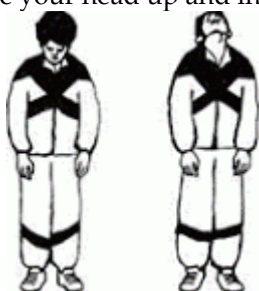


Figure 5. Head pendulum

2. Shuttle run 3x10 m (figure 6). Repeat the running technique and turns.

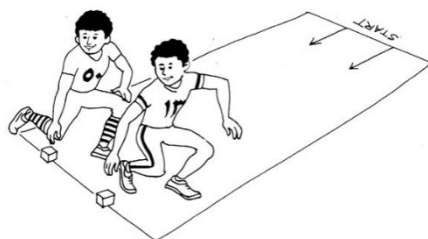


Figure 6. Shuttle run 3x10 m

From the high start position, on command "March!" run along the distance to the first line of 10 m. Behind the line there is a cube, which you need to take, make a 180-degree turn and run along the distance with the cube in your hands, to the starting line. Then put the cube behind the starting line and again make a 180-degree turn and finish, running the last 10 m.

3. Active game "Ducks and Hunters" (figure 7).

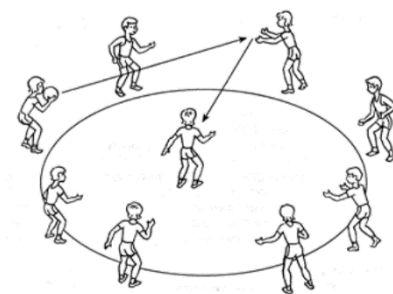


Figure 7. Ducks and Hunters

The children are divided into two teams, "ducks" and "hunters". The "hunters" team stands outside the circle, and the "ducks" stand in the circle. The "hunters" are given a light ball (100 g), which they will throw at the "ducks". At the teacher's signal, the "hunters" begin to throw the ball at the "ducks". Each "hunter" can throw the ball himself/herself or pass it to a teammate, but they cannot step outside the circle line.

The “ducks” must dodge the ball. A “duck” is considered to be knocked down if the ball hits “it” and “it” is eliminated from the game. When there are no “ducks” left in the circle, the game ends and the teams change places. The team that knocks out all the “ducks” in the least amount of time is considered the winner.

Final part – 5 minutes.

Forming the group in a line, summing up the lesson, cultivating discipline.

The assessment of the functional abilities of boys and girls is determined using 4 standard tests [2,4]:

1. The Robinson index is used to assess the level of metabolic processes in the human body. This indicator can be used to judge the oxygen consumption of the myocardium and the systolic work of the heart. The result is calculated using the formula: $\text{Pulse} * \text{Systolic pressure} / 100$

The state of the functional reserves of the cardiovascular system is assessed using the scale:

Less than 69 – excellent;

70-84 – good;

85-94 – average (we can talk about the insufficiency of the functional capabilities of the cardiovascular system);

95-110 – poor (there are signs of impaired regulation of the cardiovascular system);

111 and more – very poor (the regulation of the cardiovascular system is impaired).

2. The Skibinskaya index characterizes the functional capabilities of the respiratory and circulatory organs and is determined by the formula: $0.01 * \text{lung capacity (ml)} * \text{breath-holding time (sec)} / \text{pulse}$.

The reserves of the cardiorespiratory system according to the Skibinskaya index are assessed on the scale:

less than 5 – very bad;

5-9 – unsatisfactory;

10-29 – satisfactory;

30-60 – good;

more than 60 – very good.

3. The Shapovalova index characterizes the level of development of the functional capabilities of the cardiorespiratory system and indirectly assesses the level of development of motor qualities (strength, speed, endurance), and is calculated using the formula:

$(\text{body weight in grams} / \text{body height in centimeters}) * (\text{number of bends in 1 min} / 60)$

The results of the Shapovalova index are assessed using the scale:

Less than 200 – “low level” of the functional capabilities of the cardiorespiratory system;

200-224 – “below average” level;

225-275 – “average” level;

276-300 – “above average” level;

More than 300 – “high” level.

A low index score indicates insufficient functional capabilities of both systems and a weak level of development of motor qualities, strength, speed and endurance.

4. The Ruffier index characterizes the level of adaptation reserves of the cardiorespiratory system.

After five minutes of calm in the sitting position, the pulse is counted for fifteen seconds (p1), then 30 squats are performed within 45 seconds. Immediately after the squats, the pulse is counted for the first fifteen seconds (p2), as well as the last fifteen seconds (p3) of the first minute of the rest period. The results are assessed by the index, which is determined by the formula: $(4 * (p1 + p2 + p3) - 200) / 10$

The results of children aged 9-10 are assessed on the scale:

from 0.1 to 4.9 – “excellent”;
 from 5.0 to 9.9 – “good”;
 from 10 to 14.9 – “satisfactory” moderate heart failure;
 from 15 and more – “bad” severe heart failure.

The presented tests are valid and are often used in scientific research to determine the level of metabolic and energy processes, characterize the level of development of functional capabilities and adaptive reserves of the cardiorespiratory system [25,26].

Mathematical and statistical processing

All children's indicators were entered into the Excel table. The arithmetic mean ($\bar{X}$) and the standard deviation (SD) were determined. Using the Biostatistics 2022 program, the Student's T-Criterion was determined, the result was reliable at $p \leq 0.05$.

3. Results

Before the study, all children took control tests. The control and experimental groups were formed in such a way that there were no reliable differences between the groups for all four tests (table 1). The results of those students who attended 75% of physical education classes were taken into account.

Table 1. Indicators of both groups before the start of the pedagogical experiment

Indicators	EG $\bar{X} \pm SD$	CG $\bar{X} \pm SD$	Difference	P
Robinson index	76,1±4,1	78,3±4,6	2,9%	>0,05
Skibinskaya index	34,8±3,6	37,7±3,1	8,3%	>0,05
Shapovalova index	246,1±10,4	252,2±9,1	2,5%	>0,05
Ruffier index	8,4±1,7	8,3±1,5	1,2%	>0,05

*EG – Experimental group, CG – Control group, $\bar{X}$ – arithmetic mean, SD – standard deviation

Table 1 shows that the difference between the two groups in all tests was insignificant and statistically unreliable. For example, in the Robinson index test, the scores of children from the experimental group were on average 2.9% lower than those of children in the control group ($P > 0.05$). In the Skibinskaya index test, the average score of the control group was 8.3% higher ($P > 0.05$), and in the Shapovalova index test, it was 2.5% higher ($P > 0.05$). In the Ruffier index test, the difference was only 1.2% in favor of the experimental group ($P > 0.05$). This suggests that at the beginning of the pedagogical experiment, the control and experimental groups were homogeneous. After the end of the pedagogical experiment, all schoolchildren re-took the functional tests; the test results are presented in Table 2.

Table 2. Indicators of both groups after the pedagogical experiment

Indicators	EG $\bar{X} \pm SD$	CG $\bar{X} \pm SD$	Difference	P
Robinson index	67,7±4,7	73,4±4,4	8,4%	>0,05
Skibinskaya index	41,6±3,9	40,2±3,4	3,5%	>0,05
Shapovalova index	278,4±9,6	260,6±10,8	6,8%	>0,05
Ruffier index	7,2±1,9	7,9±1,8	9,7%	>0,05

*EG – Experimental group, CG – Control group, $\bar{X}$ – arithmetic mean, SD – standard deviation

Table 2 shows that after the end of the pedagogical experiment, the difference between the groups became reliable in three of the four tests. For example, in the Robinson index test, the difference between the groups was 8.4% ($P < 0.05$). In the Shapovalova index test, the difference between the groups was 6.8% in favor of the experimental group ($P < 0.05$). In the Ruffier index test, the difference was 9.7% in favor

of the experimental group ($P < 0.05$). As for the Skibinskaya index test, the difference between the groups was only 3.5% ($P > 0.05$). To determine the effectiveness of the third lesson of adaptive physical education, it is necessary to compare the indicators within each group from the beginning to the end of the study. The data from the control group are presented in Table 3.

Table 3. Indicators of the control group for the study period

Indicators	Before $\bar{X} \pm SD$	After $\bar{X} \pm SD$	Difference	p
Robinson index	78,3±4,6	73,4±4,4	6,7%	>0,05
Skibinskaya index	37,7±3,1	40,2±3,4	6,6%	>0,05
Shapovalova index	252,2±9,1	260,6±10,8	3,3%	>0,05
Ruffier index	8,3±1,5	7,9±1,8	5,0%	>0,05

* $\bar{X}$ – arithmetic mean, SD – standard deviation

Table 3 shows that there is a positive increase in the indicators for all four tests, but their growths are not statistically significant. For example, in the Robinson index test, the indicators improved by 6.7% ($P > 0.05$), and in the Skibinskaya index test, the average results became higher by 6.6% ($P > 0.05$). In the Shapovalova index test, the indicators became higher by 3.3% ($P > 0.05$), and in the Ruffier index test, the indicators improved by 5.0% ($P > 0.05$). A slight increase in the indicators may indicate the effectiveness of the standard adaptive physical education program in a learning disability school, which provides for 2 physical education lessons per week, and the increase in indicators can be explained by the natural growth and development of the body during the study. Table 4 presents the results of schoolchildren of the experimental group from the beginning to the end of the pedagogical experiment

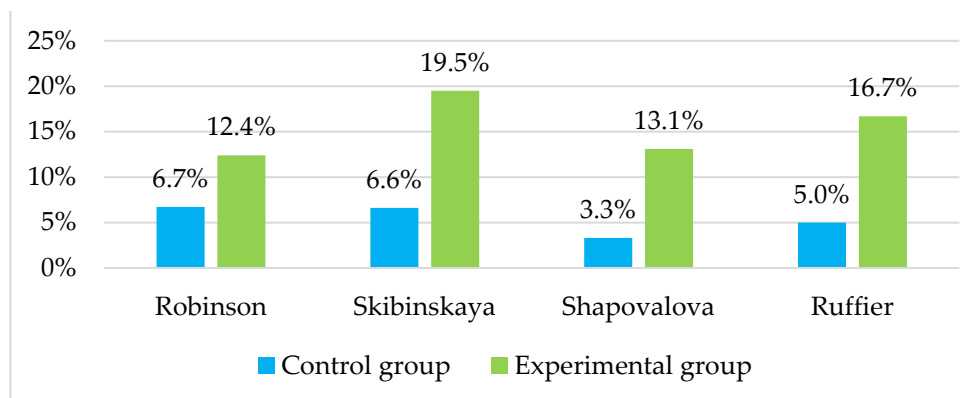
Table 4. Indicators of the experimental group during the study period

Indicators	Before $\bar{X} \pm SD$	After $\bar{X} \pm SD$	Difference	p
Robinson index	76,1±4,1	67,7±4,7	12,4%	<0,05
Skibinskaya index	34,8±3,6	41,6±3,9	19,5%	<0,05
Shapovalova index	246,1±10,4	278,4±9,6	13,1%	<0,05
Ruffier index	8,4±1,7	7,2±1,9	16,7%	<0,05

* $\bar{X}$ – arithmetic mean, SD – standard deviation

Table 4 shows that over the study period, there was a reliable increase in the results for all tests. For example, in the Robinson test, the results improved by 12.4% ($P < 0.05$), and in the Skibinskaya index test, the result improved by 19.5%. In the Shapovalova index test, the average results became 13.1% higher, and in the Ruffier index test, the results improved by 16.7%. Such results indicate a significant increase in the studied indicators, which is explained not only by the natural increase in functional data over the period of the pedagogical experiment, but also reflects the effectiveness of introducing the third lesson in adaptive physical education into the process of physical education of 9-10-year-old schoolchildren with mental retardation.

The percentage increase in the indicators for all functional tests from the beginning to the end of the study in the control and experimental groups is shown in graph 1.



Graph 1. Comparison of the growth rates of both groups over the study period

Graph 1 shows that the children of the experimental group surpassed the school-children of the control group by almost 2 times during the pedagogical experiment according to the Robinson index, and by 3 times in the Skibinskaya index and Ruffier index tests. In the Shapovalova index test, the increase in the indicators of the school-children in the experimental group was 4 times greater than that of children from the control group. Such results clearly demonstrate a significant increase in the functional abilities of children with mental retardation at the age of 9-10 during the pedagogical experiment and reflect the effectiveness of using three weekly adaptive physical education lessons compared to two lessons per week.

4. Discussion

Of all the functional deviations in human health, mental retardation is the most widespread and severe developmental defect in terms of social consequences [1,3,7]. There are more than 300 million people with intellectual disorders in the world. According to the World Health Organization, the number of people with mental retardation in economically developed countries is 1-3% [6,7]. The fact that the number of children with intellectual disorders increases every year is of particular concern [4,8].

According to experts, the above-mentioned trend will continue in the coming years, as there is an increase in the frequency of births of children with congenital physical anomalies, intellectual disorders and other diseases. The predicted increase in the number of children with special needs will create serious social, economic and psychological problems for the children themselves, their parents, and for society as a whole. This circumstance requires the creation of conditions for the correction of various developmental disorders in children with pathology, their education, professional training, and the search for ways of socialization and integration into society [11,13].

The organization of adaptive physical education in the pedagogical process of learning disability schools is of great importance for the socialization of the personality of mentally retarded children, during which mainly the correction of motor disorders, improvement of physical fitness, health level and functional abilities of children with this pathology are carried out [1,5,6].

In previous studies, the authors emphasize the importance of the problem of the development of children with mental retardation [3,5,6]. Some authors offer sets of physical exercises aimed at developing different physical abilities, which requires additional resources and attention [22-24]. Only some authors focus on physical education classes in a special school, but they do not offer a specific methodology that would significantly enhance the children's functional abilities [18,19]. In our study, for the first time, the effectiveness of using an additional lesson on adaptive physical education in correctional schools to improve the functional abilities of children aged 9-10 with mental retardation has been scientifically substantiated and experimentally tested.

Unfortunately, the process of physical education in learning disability schools is built in a standard way, adaptive physical education lessons are held only 2 times a

week and last 40 minutes each, which, in our opinion, is an insufficient load when the aim is to successfully solve the problems of physical education of mentally retarded schoolchildren. The search for a solution to this issue, as well as the most effective means, methods and technologies of physical education of students in special learning disability schools is very relevant. One of the optimal solutions to the problem is the use of an additional lesson in adaptive physical education during the week. This is confirmed by the results of the pedagogical experiment.

The Robinson index is used to assess the level of metabolic and energy processes which occur in the human body. Before the study, the average indicator of 9-10-year-old schoolchildren in the control group (76.1 ± 4.1) and in the experimental group (78.3 ± 4.6) corresponded to the "good" level of systolic work of the heart. After the experiment, the average data in the control group remained at the same level, and in the experimental group, the indicators significantly improved by 12.4% ($P < 0.05$), which corresponds to the "excellent" level of systolic work of the heart.

The Skibinskaya index determines the reserves of the cardiorespiratory system, characterizes the functional capabilities of the respiratory and circulatory organs. Before the pedagogical experiment, the average Skibinskaya Index in both groups was at the "good" level. After the end of the study, it remained in the same "good" range, but a significant and reliable improvement in indicators was achieved by the children from the experimental group 19.5% ($P < 0.05$), compared to the schoolchildren from the control group 6.6% ($P > 0.05$).

The Shapovalova index characterizes the level of development of the functional capabilities of the cardiorespiratory system and indirectly assesses the level of development of motor skills. Before the start of the study, the indicators in both groups were at the "average" level of development of the functional capabilities of the cardiorespiratory system. After the end of the pedagogical experiment, the children from the control group remained at the same "average" level, while improving the result by only 3.3% ($P > 0.05$). The children from the experimental group improved their indicators to 278.4 ± 9.6 , and the increase was 13.1% ($P < 0.05$), which corresponds to the "above average" level.

The Ruffier index characterizes the level of adaptive reserves of the cardiorespiratory system. At the beginning and at the end of the study, the indicators of the schoolchildren in both groups corresponded to the "good" level of adaptive reserves of the cardiorespiratory system. However, in the experimental group, a significant improvement in the indicators was noted from 8.4 ± 1.7 to 7.2 ± 1.9 , and the increase was 16.7% ($P < 0.05$), in contrast to the schoolchildren from the control group, whose average increase was only 5% ($P > 0.05$).

Thus, the results of the study experimentally proved the effectiveness of using the third lesson of adaptive physical education when working with mentally retarded children in a learning disability school. However, it should be noted that due to the small sample, the current study can be considered a starting point for further research in this direction. Future studies can determine the impact of the third lesson of physical education per week on the indicators of the leading physical qualities of children of different ages and genders.

5. Conclusions

The results of the study proved the effectiveness of using the third lesson of adaptive physical education in correctional schools in working with children with intellectual disabilities. Schoolchildren who engaged in adaptive physical education 3 times a week were able to significantly outperform children who engaged in physical education 2 times a week in all indicators.

Of course, the topic of developing the physical and functional abilities of children with mental retardation is relevant, and should be studied further. Thus, it is necessary to study the influence of physical activity on the development of not only functional

abilities, but also on the development of physical qualities (for example, coordination abilities, speed or strength qualities).

When working with children in learning disability schools, it is recommended to use games, introduce elements of competition, and apply various forms of encouragement.

Demonstration of an exercise is a teaching method that should be widely used in working with mentally retarded children. It is important that the movements learned in classes are clearly visible to each child. It is necessary to include active games in the program of classes. It is proven that it has a health-improving and developmental effect, serves as an effective means of neuropsychic relief.

Author Contributions: Conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing original draft preparation, writing review and editing, visualization, supervision, project administration, funding acquisition – G.G.P.

Funding: This work was not supported by a funding source.

Institutional Review Board Statement: The study was conducted in accordance with the latest version of the Declaration of Helsinki and was approved by the local Ethics Committee of the University. Protocol № 4. Date: 11.09.2023.

Informed Consent Statement: All participants and their parents were informed of the potential benefits and risks before signing the consent form.

Data Availability Statement: Not applicable.

Acknowledgments: The authors would like to thank all participants of the scientific research.

Conflicts of Interest: The author declares no conflict of interest.

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