Research Paper

Study and Assessment of Motor Abilities of Older Children of Pre-school Age With Speech Disorders

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ABSTRACT

Objectives: The urgency of the given study is in the lack of knowledge of various types of motor abilities of older pre-school children with speech disorders and the need to realize an individually differentiated approach to provide the environment for their development. In the current study, it was tried to identify and assess the level of development of motor abilities in older pre-school children with speech disorders.

Methods: The study included 200 older pre-school children, 100 children with a healthy level of speech development, and 100 with a speech disorder in the Belgorod and Belgorod region (Russian Federation). The study looked at scientific sources using motor abilities testing (motor coordination, speed, strength, strength, plasticity, and stamina). Methods of mathematical statistics (student's t-test) using the SPSS software, version 26 were used to calculate the statistic problems.

Results: The study and assessment of motor abilities of older pre-school children showed the predominance of an insufficient level of development of motor and coordination abilities in both neurotypical children and those with a language disorder. In both groups, children performed the worse left-hand task (the insufficient level was noted in children with speech disorders in 100% of boys and girls; in the group of children with a healthy level of speech development – in 84.1% of boys and 81.5 % of girls). When performing the right task hand, an insufficient level was noticed in children with speech disorders in 95.5% of boys and 96.4% of girls; in the group of children with a healthy level of speech development–in 77.3% of boys and 74.1% of girls. Diagnosis of other motor abilities states the dominance of the insufficient level only in children with speech disorders: strength abilities (70.5% of boys and 72.3% of girls), speed and strength abilities (68.2 % of boys and 67.9 % of girls), stamina (77.3% of boys and 75% of girls), and plasticity (65.9% of boys and 62.5% of girls). The veracity of the results was confirmed through the student's t-test. The observed differences were statistically significant.

Discussion: The obtained findings and assessment of motor abilities confirm developmental lag in older pre-school children with speech disorders. In children, low indicators in the level of development of motor-coordination abilities and stamina prevailed.

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Highlights

- 200 older pre-school children with a healthy level of speech development and a speech disorder were studied.
- Normal children with children who had speech disorders were compared.
- The development of motor abilities in older pre-school children with speech disorders was evaluated.

Plain Language Summary

The results of this study on 200 older pre-school children (100 children with a healthy level of speech development and 100 with a speech disorder) showed that the development of motor abilities in pre-school children contributes to the formation of children's primary, fine, and articulatory motor skills. Creating an environment for writing and reading acquisition and the development of sensory and intellectual spheres are one of the groundwork for overcoming speech violations. Individually differentiated approaches for the development of motor abilities of older pre-school-age children with speech disorders affect the special learning process. It identifies the features of motor ability characteristic of these children. The results of various tests in older pre-school children with speech disorders demonstrated that they lag behind their peers with healthy speech development. Compared with normal children, children with speech disorders had the least developed coordination, motor skills, and endurance and also had difficulty using their left hand to write. Considering gender differences, there was no notable difference in the task performance of both boys and girls, considering their gender differences. The student's t-test confirmed the trustworthiness of the differences in the statistical characteristics obtained during the study.

1. Introduction

The focus for the study of motor abilities development in pre-school children is related to the physiological need for a growing child in motion, the interaction and intersectionality of motor, speech, and mental development in ontogenesis, further education at the school, and the written speech mastery, and the need to ensure an individually differentiated approach in the development in taking the content of the educational areas of the pre-school level of education [1].

Physiological and psychophysiological research literature has proved the effect of the motor analyzer on the functional development of various areas of the brain [2]. The effect of motor activity, particularly finger movements, on the maturation of the central nervous system and the functional state of the brain, on the improvement of the sensory side of speech and motor realization of speech, and the formation of the generalizing function of the word has been experimentally proved [3-5].

It is a scientific fact that the close relationship between motor and speech development is one of the key grounds that determines the success of the formation of the "sensory-motor level of consciousness" of the child and, as a result, ensures the development of the basic elements in personality development [6, 7]. The sensory-motor disorder development of pre-school children can cause difficulties in receiving and processing information from various analyzers (visual, auditory, tactile, kinesthetic, and others) that provide knowledge of the child's environmental reality and intellectual development [8].

The studies of the motor abilities of children with speech disorders note the presence of general motor disorder [9]. But in most studies, according to Dudyev, attention is paid to the description of motor insufficiency, which leads to speech pathology. A detailed description of motor disorder is given only in relation to children with cerebral palsy, which they are the primary link in the state defect [5].

Voloshina [10], Gimazov [11], and Lyakh [12] considered motor abilities, as the ground for their formation, composition, structure, and forms of manifestation in their studies. Motor abilities are treated as individual human characteristics that determine the level of his motor abilities [13], which are "potential mobility" [14]. Researchers point out that motor abilities are the result of the interaction of heredity and environmental factors that determine their manifestation and development when performing activities.

Some studies have indicated that the two functional systems (speech and motor) are mutually dependent on each other in all syndromes [6, 15]. Nosenko noted that children aged 5-7 years with speech disorders have an insufficient level of physical strength in comparison with their neurotypical peers. At the same time, the researcher pointed out that their anthropometric indicators correspond to the average values of the age group calculated for children without speech disorders. This circumstance indicates the absence of an unambiguous relationship between the level of speech and physical development based on their morphofunctional indicators [16].

The research works of Dudiev, which are devoted to the physiological aspects of the intersection between motor and speech functional systems, indicated the complexity of this process. The quality of motor experience is directly affected by both the nature of the child's motor activity and the degree of his inclusion in various types of communicative situations [6].

In the process of active movements, the endurance of the muscles increases, providing the child with the opportunity to stay in a static working posture for a long time in the pre-school classroom and at the desk in the classroom at school [17, 18]. For the learning process, an adequate level of development of fine motor skills is not less important. The finely differentiated movements of the child's hands ensure the performance of graphomotor operations when writing 3. Motor abilities and gestures can perform a compensatory function in overcoming speech disorders [19, 20].

In children with speech disorders, the study of motor abilities is of particular significance due to the fairly high frequency of their occurrence in the children and, accordingly, in pre-school educational organizations, the frequent neurological burden of their psychophysical development, which may affect the development of the motor analyzer, the need to provide compensatory mechanisms of speech development by activating the preserved analyzer systems, and the special significance of motor and speech development in the formation of children's life competence, socialization, and integration.

Some works describe general motor disorders [15, 20], and others present data on the features of the motor sphere of learners with writing disorders [21, 22]. Coordination abilities were mainly studied in pre-school-children with speech disorders [23-25]. But other types of motor abilities in pre-school children with speech disorders are not well understood, which prevents them from ensuring the individually differentiated approach to create conditions, and select means, forms, and methods of their physical development. Due to the lack of knowledge of various types of motor abilities of older preschool children with speech disorders and the need to realize an individually differentiated approach to provide the environment for their development we determined and evaluated the level of development of motor abilities in older pre-school children with speech disorders.

2. Materials and Methods

During the growth and development of the child, different motor skills are developed; thus, the subjects of this study were 5-year-old children. To select the type of skills to be evaluated, it was necessary to perform the test on healthy 5-year-old children. Based on the pretest, 100 healthy 5-year-old children were selected from a preschool center, and the test was performed on them. In order not to affect their education, children who did not attend the center for more than two months were selected. The test used in this study was the "Oseretsky test" [26], which examines the development of motor skills in children and adolescents aged 5 to 14 years. This test consists of 36 items that are gradually becoming more difficult. This test includes subtests, such as walking backward, standing on one foot, touching the tip of the nose with a finger, etc. Finally, Oseretsky's movement test was performed on these 100 children, of which out of 36 items in this test, only 13 items received full marks. Thus, these 13 items were selected for the study of 5-year-old children with production disorders.

The study involved 100 children with a healthy level of speech development and 100 with speech disorders. We looked at scientific sources and motor abilities testing to achieve the objective.

To study motor-coordination abilities, we used tests, such as throwing and catching a ball, hitting a horizontal target from a distance of 3 m, and to study plasticity, leaning forward from a standing position on a gym bench, to study speed and strength abilities-standing start, standing long jump, to study strength abilities-rise lying down, throwing a softball, and to study stamina-running length, methods of mathematical statistics (student's t-test) were used.

TOLD language test [27, 28] was performed to ensure that there was no language problem. Since phonological and phonological differentiation is a difficult task, considering that there are eight criteria for differentiating production disorder of phonological origin and production disorder of phonological origin (children with more

than five criteria in favor of phonology), children who had more than five criteria in favor of phonology were included in the phonological group. For differential diagnosis, and evaluation of productive organs, auditory Wepman's test [29], oral-diadochokinesis test [30], and video production test (phonetic test) were performed [31, 32]. Unstabilized lateral superiority was excluded from the study.

When assessing the motor abilities of older pre-school children, we focused on the minimum indicators of physical development of preschoolers, stated in the educational programs "origins" [33] and " success" [16].

Finally, Oseretsky's motor test was performed to assess these children's motor abilities. This test divides motor skills into five general categories: fine movements, large movements, two-way motor coordination, eye-hand coordination, and balance. Finally, the information obtained from this study was evaluated using the SPSS software, version 26, independent t-test, and paired t-test.

3. Results

We conducted a study of the motor abilities of children of older pre-school with speech disorders and children of the same age group without speech disorders. In the experimental work, we used tests to study the level of development of such motor abilities as motor coordination abilities, plasticity, speed-strength abilities, strength abilities, and stamina.

The obtained results are presented in Tables 1-5.

The findings obtained in the study of motor coordination abilities showed differences in the measurement of indicators when children performed the tests "throwing and catching the ball" and "hitting a horizontal target from a distance" (Table 1).

Results in the indicator "throwing and catching the ball" in boys with speech disorders differed from those with a healthy level of speech development by 31.68% (P<0.05). In girls, respectively, the differences in the results were 35.63% (P<0.05). According to the indicator "hitting a horizontal target from a distance" for the right hand, the result in boys with speech disorder differed from boys with healthy speech development by (35.81%; P<0.05) and for left hand by 39.52% (P<0.05). The most significant differences in this indicator revealed the difference of 52.08% (P<0.05) for the left hand, and 23.68% (P<0.05) for the right hand of girls.

Table 1. The results of the assessment of older pre-school children's motor coordination abilities

Tests	Gender	Children With a Healthy level of Speech Development			Children With Speech Disorders			t	P	Dif. %
		O	S	I	O	S	I			
Throwing and catching the ball	b	8.8	36.9 18.50±1.72	54.3	0	31.8 12.64±1.40	68.2	2.64	<0.05	31.68
	g	12.9	31.5 17.15±1.83	55.6	0	28.6 11.04±1.51	71.4	2.58	<0.05	35.63
Hitting a horizontal target from a distance of 3 м, м b_1,g_1–r. h b_2,g_2–l. h.	b_1	0	22.7 1.48±0.22	77.3	0	4.5 0.95±0.14	95.5	2.08	<0.05	35.81
	g_1	0	25.9 1.52±0.14	74.1	0	3.6 1.16±0.11	96.4	2.02	<0.05	23.68
	b_2	0	15.9 1.24±0.14	84.1	0	0 0.75±0.10	100	2.85	<0.05	39.52
	g_2	0	18.5 0.96±0.12	81.5	0	0 0.46±0.07	100	3.60	<0.05	52.08

Abbreviations: O: Optimal level; S: Sufficient level; I: Insufficient level.

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Table 2. The results of the assessment of older pre-school children's plasticity

Tests	Gender	Children With a Healthy Level of Speech Development			Children With Speech Disorders			t	P	Dif. %
		O	S	I	O	S	I			
Leaning forward from a standing position on a gym bench (cm)	b	4.4	54.3 3.92±0.05	41.3	0	34.1 2.78±0.20	65.9	5.53	<0.05	29.08
	g	5.6	57.4 6.74±0.19	37	0	37.5 3.57±0.41	62.5	6.88	<0.05	29.08

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Comparing the results of the assessment of motor abilities (plasticity) in terms of "lean forward from a standing position on a gym bench", the most significant differences were found in girls with 47.03% (P<0.05) and in boys, the difference was 29.08% (P<0.05) (Table 2).

"Speed and strength abilities" using motor abilities test showed that the results in boys and girls were most significantly different in terms of "standing start" by 15.13% and 14.77%, respectively (P<0.05) (Table 3).

Regarding the indicator "standing long jump", the results of boys with speech disorders differed from those with healthy speech development by 9.05% (P<0.05). Girls had up to 8.92% (P<0.05) (Table 3).

Regarding the diagnostics of motor abilities, and concerning the "strength capacities" the results of boys in terms of "rise to lie down" differed by 33.86% (P<0.05) and in terms of "softball throw", by 32.39% (P<0.05) (Table 4).

In girls with speech disorders and those with a healthy level of speech development, the difference was 31.68% (P<0.05) for the first indicator and 38.17% (P<0.05) for the second indicator (Table 4).

Regarding "running length" (motor abilities "stamina"), the difference between boys with speech disorders and those with healthy speech development was 62.11% (P<0.05). In girls with speech disorders, the difference in the result was 60.49% (P<0.05) (Table 5).

4. Discussion

Research literature discusses the features of the motor sphere of elementary school children with speech disorders. Camorin and Kornev indicated the marked kinetic and dynamic disorder of motor function of the hands of learners to replace the kinetically similar letters [29, 30].

Table 3. The results of the assessment of older pre-school children's speed and strength abilities

Tests	Gender	Children With a Healthy Level of Speech Development			Children With Speech Disorders			t	P	Dif. %
		O	S	I	O	S	I			
Standing start 10 m, s	b	4.4	54.3 3.37±0.16	41.3	0	31.8 3.88±0.17	68.2	2.18	<0.05	15.13
	g	0	53.7 3.52±0.13	46.3	0	41.1 4.04±0.16	58.9	2.52	<0.05	14.77
Standing long jump (cm)	b	4.4	45.6 100.43±2.07	50	0	31.8 91.23±2.43	68.2	2.88	<0.05	9.05
	g	3.7	55.6	40.7	0	32.1	67.9	6.48	<0.05	8.92

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Table 4. The results of the evaluation of older pre-school children's strength capacities

Tests	Gender	Children With a Healthy Level of Speech Development			Children With Speech Disorders			t	P	Dif. %
		O	S	I	O	S	I			
Rise lying down, number of times	b	19.6	28.2 9.42±0.59	52.2	0	29.5 6.23±0.62	70.5	3.73	<0.05	33.86
	g	13	22.2 8.08±0.56	64.8	0	26.8 5.52±0.50	73.2	3.41	<0.05	31.68
Softball throw (cm)	b	30.4	32.6 130.37±11.88	37	0	29.5 88.14±11.96	70.5	2.51	<0.05	32.39
	g	48.1	27.8 123.24±7.09	24.1	0	28.6 76.20±7.95	71.4	4.42	<0.05	38.17

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Marked difficulties in pre-school children with speech disorders when performing movements for static and dynamic balance, in performing practical movement buildings, numerous synkinesia, motor disturbance, etc., lead to further writing disturbance at school age. Moreover, these children often have difficulties with orientation in space, violations of spatial praxis, and inferiority of visual-motor coordination [34, 35]. The study of scientific literature showed insufficient knowledge and characterization of various types of motor abilities of pre-school children with speech disorders. Studies have demonstrated that speech and motor are mutually dependent on each other. Other studies have shown that children (aged 5-7 years) who suffer from speech disorders have poorer physical strength than their neurotypical peers. Researchers found that anthropometric indicators correspond to the average values of the age group calculated for children without speech disorders. This case reveals the absence of an unambiguous association between the level of speech and physical development based on their morphofunctional indicators [5, 15, 16].

The main groups of motor abilities include strength, speed, speed and strength, the ability for long-term performance, coordinating ability, stamina, and plasticity [36]. In modern scientific and technological progress, among these motor skills, an important place is occupied by the coordinating ability [13]. Motor skills, as forms of manifestation of motor abilities, consistently arise in the process of formation of motor action [34].

In analyzing the quantitative evidence of the assessment of all types of motor abilities of children in this study, it should be stated that the most difficult test for children with both a healthy level of speech development and speech disorders was the "hitting a horizontal target from a distance of 3 m" (diagnosis of motor coordination abilities). At the same time, in both groups, left-hand-

Table 5. The results of the assessment of older pre-school children's stamina

Tests	Gender	Children With a Healthy Level of Speech Development			Children With Speech Disorder			t	P	Dif. %
		O	Д	Н	O	Д	Н			
Running length (min)	b	13.1	56.5 7.68±0.38	30.4	0	22.7 2.91±0.33	77.3	9.48	<0.05	62.11
	g	14.8	59.3 7.01±0.30	25.9	0	25 2.77±0.27	75	9.51	<0.05	60.49

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ed children performed worse (an insufficient level was noted in the group of children with speech disorders in 100% of boys and girls; in the group of children with a healthy level of speech development – 84.1% of boys and 81.5% of girls). When performing the task right-handed, an insufficient level was noticed in the group of children with speech disorders in 95.5% of boys and 96.4% of girls; in the group of children with a healthy level of speech development – in 77.3% of boys and 74.1% of girls.

The test results, with close reference to the prevalence of tasks, performed deficit at throwing, and catching the ball (in the group of children with speech disorders: 68.2 % of boys and 71.4% of girls), confirmed the findings concerning the lack of development in children of pre-school age coordination abilities, which is due to the missing of purposeful, planned, and systematic work [29, 35].

The results of the study speak about a predominantly motor abilities development deficit in children with speech disorders, such as stamina, plasticity, strength, and speed, and strength abilities.

The dominance of deficit in comparison with other tasks was noted when children of pre-school age with speech disorders performed the “running length” test: 77.3% - of boys and 75% - of girls, which indicates the lack of formation of such a group of motor abilities as stamina that in the future can have a negative effect on the children’s willingness for school.

5. Conclusion

The study results and analysis of scientific literature showed that the development of motor abilities in children of pre-school age contributes to the formation of children’s main, fine, and articulatory motor skills. In the correctional and educational process of older children of pre-school age with speech disorders, this is one of the groundworks for overcoming speech violations, creating an environment for writing and reading acquisition, and the development of sensory and intellectual spheres, the insufficiency of which is included in the structure of the impediment to speech disorders. The realization of individually differentiated approaches for the development of motor abilities of older pre-school age children with speech disorders affects the special and learning process and identifies the features of motor abilities characteristic of these children.

The study results and assessment of various motor abilities in older children of pre-school age with speech disorders indicate that they lag behind their peers with healthy speech development. Coordination, motor abilities, and stamina were the least developed in children with speech disorders. These children had difficulties in performing test tasks with the left hand, in contrast to the normotypic peers, among whom were children with an acceptable level. In the course of the study, there was no significant difference in task performance by both boys and girls, taking into account their gender differences. The reliability of the differences in the statistical characteristics obtained during the study was confirmed through the student’s t-test.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles are considered in this article. The participants were informed of the purpose of the research and its implementation stages. They were also assured about the confidentiality of their information and were free to leave the study whenever they wished, and if desired, the research results would be available to them. A written consent has been obtained from the subjects.

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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