FEATURES OF BALANCE IN PRESCHOOL CHILDREN

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ABSTRACT
A sedentary lifestyle leads to a continuous decline in physical activity among children. Limited motor activity and insufficient movement have highly adverse effects on their health, physical development, and overall fitness. The educational area of 'Physical Culture' in preschool aims to foster the comprehensive development of children, which affects their health, physical development, fitness, cognitive activity, emotional satisfaction from motor activity, communication skills, and more.
Based on the multiple influences and specificity of motor activity, this study aims to investigate the changes in balance manifestation in preschool children. To achieve this goal, we conducted a one-time testing of 1356 children (729 boys and 627 girls) in kindergartens in different districts of the country.
The study was conducted using the 'Balance' test, which assesses body balance. The object of this research is to study balance in preschool children. The subject of the study is the peculiarities in the manifestation of balance among different age groups of preschool children. The test data were subjected to variation and comparative analysis, enabling further examination and interpretation of the results. As a result of our research work, we identified specific characteristics and changes in the manifestation of balance.

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INTRODUCTION

The physical development of children in preschool age is essential for their overall health, emotional well-being, and cognitive growth. At the same time, motor development is a key foundation for optimal physical development. It is vital for the development of motor skills and qualities, which are formed and refined at this age through play and natural movements.

These activities are typically conducted during physical education classes, which are part of the mandatory curriculum for children in kindergarten and fall under the cultural-educational field of "Physical Culture." In this area, some objectives aim to promote good health, physical development, and physical fitness; enhance cognitive activity and emotional satisfaction through motor activities; and develop play and communication skills through games. At least three pedagogical situations are implemented weekly for each age group. The results are distributed into several educational cores: "Naturally-applied motor activity," "Sports-preparatory motor activity," "Physical fitness," and "Playing motor activity." (Regulation No. 5 from 03.06.2016 on preschool education. Amended in State Gazette, issue 46 from 17.06.2016).

Research by some authors shows that organized and purposeful physical activity can significantly improve both motor abilities and cognitive functions in children. For example, Kojić et al. (2024) found that a structured motor program with games and exercises leads to significant improvement in movement coordination and balance in children, which can be considered components of the motor ability "agility." At the same time, Shtereva (2024) emphasizes that the ease with which children acquire motor skills can be a reliable indicator of the degree of development of their coordination abilities, namely, agility and flexibility.

Numerous authors emphasize the importance of integrating innovative methods, including game-based models (Paskaleva, Ivanova, & Pavlova, 2019; Kojić et al., 2024). This is also confirmed by authors H.S. Choi et al. (2014), who argue that motor activity and sport contribute to a healthy lifestyle, enabling children to acquire motor, social, and cognitive skills. "Posture in preschool children is an indicator of proper development of motor functions and affects their future physical activity." (Filkova & Usheva, 2015). Ignatova (2018) presents a methodology for integrating yoga exercises and movement games into children's daily activities in kindergarten, aiming to prevent spinal deformities and improve posture by developing balance and

coordination. The correct approach in physical education for children leads to the development of skills for independent thinking, successful task management, and a clear understanding of the surrounding reality (Yaneva, 2009).

At this stage of a child's development, balance stability, also referred to as "balance" by some authors, is of great importance. Although scientific research shows less interest in this human ability, it remains an integral part of children's motor abilities. It can be defined as one of the fundamental characteristics of an individual's motor development.

There are various definitions of balance stability in the literature. M. Pendeva (2000) views balance stability from a biomechanical perspective as the ability of a person to maintain a specific posture, which requires the fixation of individual links in the biomechanical system and the prevention of external forces from changing the position, orientation in space, and time with support. B. Parvanov (2001) defines balance stability as "balance sensitivity," which depends on two factors: the vestibular system and vision. This is also supported by Woollacott (2013), who describes balance as being controlled by the central nervous system, which integrates visual, vestibular, and proprioceptive information, transmits it to the brain, and then sends signals to the muscles and muscle groups involved in performing the movement. Thanks to the proprioceptive function of the human body, we can engage various mechanoreceptors and regulate them to establish correct positioning and movement in space.

Authors studying balance issues note that its development and refinement are necessary throughout the entire growth period. All motor activities of children are related to maintaining a stable body position (Nazarenko, 1999; Lyakh, 1991, 1996). Payne & Isaacs (2017) dedicate significant attention to balance stability, including theoretical explanations, practical links to basic motor skills, and the role of the senses. According to Dimitrova et al. (2016), working on dynamic balance stability is desirable during physical training.

METHODOLOGY

Based on the analysis and interpretation of literary sources related to the studied age group, *this study aimed* to identify changes in the manifestation of balance stability in preschool-aged children. To achieve this objective, we set the following *tasks*:

Analysis of the issue across various literary works.

Sports-pedagogical testing of children from the second, third, and fourth preschool age groups.

Analysis and interpretation of the study's results to reveal changes in the manifestation of balance stability in preschool-aged children.

The objective of the study is to examine how balance stability manifests in preschool-aged children. The focus is on the characteristics of balance stability across different age groups within the preschool period.

The study was conducted in 2024 across 13 different kindergartens in 7 Bulgarian towns. Children from the second, third, and fourth preschool groups were tested using the "Balance" test. All participants studied have signed an informed agreement that the information received from the tests will be used in the present survey. The test was performed on a non-slip hard or hard-elastic surface, with a turned-over gymnastics bench placed on it. Initial position: The child stands on the overturned bench, bends the left knee, and places the foot to the side of the right leg so that the left foot touches the right knee. Hands are placed on the hips. The child maintains this balanced position for as long as possible. The duration of this balance is recorded. Time is measured for both the right and left legs.

The results obtained from the testing were processed using the statistical software SPSS v25. The data were subjected to variation and comparative analysis. We subjected the obtained data to variational and comparative analysis. For the comparative analysis, we used the non-parametric Mann-Whitney U test. A total of 1,356 children participated in the study. Their distribution by age group is presented in Table 1.

Table 1. *Distribution of the examined children by age group.*

Age Group	Boys	Girls	Total
II age group	270	215	485
III age group	245	212	457
IV age group	214	200	414
Total	**729**	**627**	**1356**

RESULTS

The analysis of the results from the conducted study begins with examining the statistical indicators involved in the variation analysis. Their presentation and interpretation will serve as a basis for choosing the appropriate statistical criteria to compare the performance of different tested groups of children.

Table 2. *Results from the Variation Analysis – Boys*

Test	Group	*N*	Min	Max	*Mean*	*SD*	V%	As	Ex
Balance – left leg	II	270	1.10	56.63	11.94	9.55	79.98	1.69	3.62
Balance – right leg			1.13	62.81	13.46	11.86	88.11	1.87	3.65
Balance – left leg	III	245	1.20	53.77	16.48	9.97	60.49	0.82	0.30
Balance – right leg			1.03	59.65	16.83	11.10	65.95	1.04	0.95
Balance – left leg	IV	214	0.04	97.23	17.12	17.10	99.83	1.90	5.00
Balance – right leg			0.06	81.47	17.75	16.16	91.04	1.34	1.65

The coefficients of skewness (As) and kurtosis (Ex) in Tables 2 and 3 exceed the table values in all cases, indicating a lack of normal distribution. These high values can be attributed to the highly individualized manifestation of motor skills among the tested children. These values of the coefficients of skewness (As) and kurtosis (Ex) justify the use of non-parametric statistical methods for hypothesis testing to identify age-related differences in balance stability.

Table 3. *Results from the Variation Analysis – Girls*

Test	Group	*N*	Min	Max	*Mean*	*SD*	V%	As	Ex
Balance – left leg	II	215	1.26	87.26	12.97	9.49	73.16	3.20	18.91
Balance – right leg			1.70	73.69	13.47	9.71	72.08	2.97	8.80
Balance – left leg	III	212	1.03	43.00	17.03	9.72	57.07	0.56	-0.34
Balance – right leg			1.08	49.54	17.75	10.40	58.59	0.74	-0.09
Balance – left leg	IV	200	0.14	98.00	20.35	18.52	91.00	1.61	3.01
Balance – right leg			0.11	80.00	23.48	18.68	79.55	0.86	0.008

The coefficient of variation (V%), a component of variation analysis, provides information on the spread of results across different age groups. For all three preschool age groups, the values exceed 30%, indicating significant variability in children's performance. This supports the earlier assumption of highly individual differences in motor abilities, likely a result of declining levels of physical activity in early childhood, as noted by various authors. From a practical perspective, this also suggests a large potential for its improvement in the relevant age groups. Therefore, pedagogical situations in kindergartens should be individualized in terms of tools and methods used.

Table 4. *Comparative analysis of the test – "Balance with a left and right leg"*

Test	Group	Boys	Girls	*d*	*p*
		Mean	*Mean*		
Balance – left leg	II	11.94	12.97	-1.03	.017
	III	16.48	17.03	-0.55	.422
	IV	17.12	20.35	-3.23	.001
Balance – right leg	II	13.46	13.47	-0.01	.069
	III	16.83	17.75	-0.92	.277
	IV	17.75	23.48	-5.73	.001

Table 4 presents the differences in balance performance between the left and right legs across the three age groups. The data indicate that the average balance performance for both legs is similar between girls and boys. However, girls generally demonstrate better balance abilities. The gender gap increases with age, as seen in all three groups and for both legs, with girls consistently scoring higher. Not all gender differences are statistically significant. Notably, the left leg balance results in the II and IV age groups show girls outperforming boys by 1.03 seconds and 3.23 seconds, respectively, and the necessary levels of significance support these differences.

In terms of balance with the right leg, girls also show better averages, with the only statistically significant difference in the oldest group (IV)—6-year-olds—where the difference is 5.73 seconds, with statisticaly significant difference (p = .001)

We also examined age-related aspects of balance stability. Since we are comparing three groups and there is no normal distribution, we used the non-parametric Wilcoxon *T*-test. The results are shown in Tables 5 and 6, as well as in Figure 1.

Table 5. *Comparison of performance across the three age groups – boys*

"Balance" test	Group	Group	*d*	*p*
Right leg	II	III	- 4.53	<.001
		IV	- 5.17	<.001
	III	IV	- 0.63	.893
Left leg	II	III	- 3.37	.010
		IV	- 4.28	.001
	III	IV	- 0.91	.735

As shown in Figure 1, both boys and girls show positive developmental dynamics in balance stability for both left and right legs. This improvement is significantly higher in girls, with an increase of 7.38 seconds for the left leg and 10.78 seconds for the right leg over the study period. In comparison, boys improved by 4.28 and 5.17 seconds, respectively. These differences are statistically significant, confirmed by a highly significant effect (p = .001)

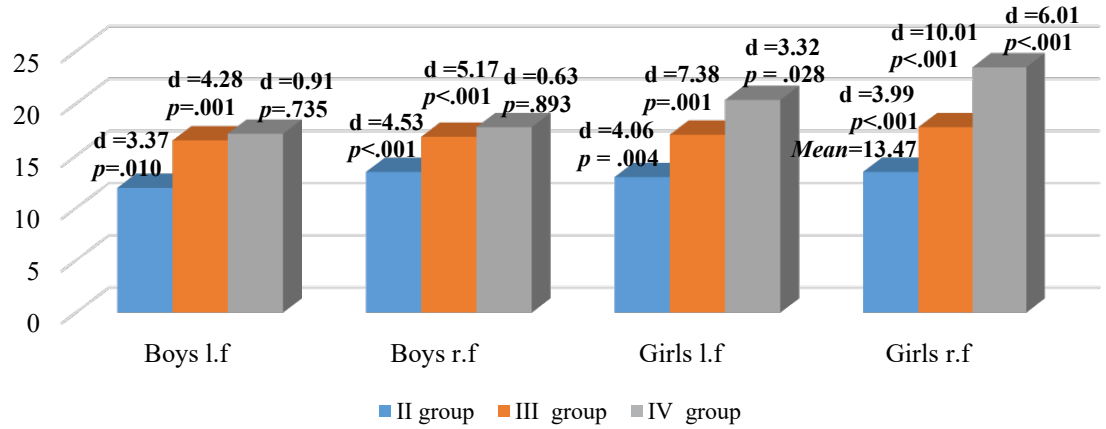

Figure 1. *Comparison of performance across the three age groups*

Examining the figure, we can observe that the greatest increase in performance between age groups occurs between 4 and 5 years, where improvements across all comparisons range from 3.37 to 4.53 seconds. These findings are confirmed with high levels of statistical significance. In contrast

to boys, among girls, the trend of improvement in the examined motor ability continues between the fifth and sixth years of age. Another feature of the dynamic changes in balance stability among girls is that it is consistent and gradual during the period between their fourth and sixth years of age. For boys, however, the changes observed between the fifth and sixth years are not statistically significant.

Table 6. *Comparison of performance across the three age groups - girls*

"Balance" test	Group	Group	*d*	*p*
Right leg	II	III	- 3.99	.006
		IV	- 10.01	<.001
	III	IV	- 6.01	<.001
Left leg	II	III	- 4.06	.004
		IV	- 7.38	<.001
	III	IV	- 3.32	.028

Another key aspect of this analysis is the undeniable effect of biological age on balance stability, which is evident in both boys and girls. It is also important to note that this age-related influence plays a role in the observed gender differences.

DISCUSSION

The present study aimed to investigate the characteristics of balance stability manifestation in preschool children, focusing on age and gender dynamics. The analysis of the results reveals several key trends that merit an in-depth interpretation in the context of contemporary scientific literature. Our main findings show a clear positive dynamic in the development of balance stability with advancing age in both boys and girls. This result is entirely expected and corresponds with fundamental theories of motor development, according to which the preschool period is a sensitive one for the formation and refinement of basic motor skills. Authors such as Payne & Isaacs (2017) also emphasize that balance is a key component of motor development at this stage. The observed progressive improvement in results reflects the maturation processes of the central nervous system, which integrates visual, vestibular, and proprioceptive information to maintain posture. A significant result from our research is the established gender-differentiated manifestation of the studied quality. Girls demonstrate a better-developed ability to maintain balance, and this difference increases with age. While girls show statistically significant and consistent progress between each of the studied age groups (II, III, and IV), for boys, the most substantial leap is between the ages of four and five, after which development slows, and the change between ages five and six is not statistically significant. This particularity can be explained by the earlier biological maturation in girls, which affects neuromuscular control and coordination abilities. The difference in preferences for various types of games and motor activities between the genders may also contribute to these results. The data from the variation analysis show significant variability in the individual achievements of the children (V% > 30%) across all groups. This confirms the thesis of the highly individualized nature of motor development and may be a reflection of decreasing motor activity in early childhood, as noted in the introduction. The wide dispersion of the results suggests that there is significant potential for development and improvement through targeted pedagogical work. This conclusion supports the findings of authors such as Kojić et al. (2024) and Paskaleva, Ivanova, & Pavlova (2019), who demonstrate that structured and game-based motor programs lead to significant improvements in children's motor abilities

CONCLUSION

In conclusion, based on the conducted study, we can summarize that between the ages of four and six, there are significant positive changes in the dynamics of balance stability development. Moreover, the manifestation of this motor skill is gender-differentiated. Among girls, significant improvements are observed between each successive age group, while in boys, the most notable improvement occurs between the ages of four and five.

These findings enable us to recommend, on the one hand, targeted work to enhance balance stability throughout the entire preschool period, and on the other hand, customized approaches tailored to the capabilities of boys and girls, in order to stimulate their full-fledged motor and physical development.

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