STATIC BALANCE AND GENERAL COORDINATION IN MIDDLE SCHOOL STUDENTS: A COMPARATIVE ANALYSIS BY GENDER

Florin COTOS[1]*, Bogdan-Constantin UNGUREAN[2]

[1*]*PhD Student, Doctoral School in Science of Sport and Physical Education, „Al. I. Cuza" University of Iasi, Romania*
[2]*Professor PhD Hab., Faculty of Physical Education and Sports, "Al. I. Cuza" University of Iasi, Romania*
* Corresponding Author: cotosf@yahoo.com

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Abstract: The purpose of this study is to examine whether gender differences exist in the level of motor indices, static balance, and general coordination among middle school students. The study was carried out between April and June 2025 at "Grigore Ghica Voievod" Lower Secondary School in Suceava and included 111 students (44 girls and 67 boys). Static balance was assessed using the Flamingo Test, and general coordination was assessed using the Matorin Test. The analysis of the results indicates differences between the two groups for both static balance and general coordination. Girls recorded better results in static balance (a lower Flamingo Test score = superior static balance performance) (MA = 18.54 for boys and MA = 16.77 for girls), t(109) = 2.170, Sig. < 0.05, mean difference = 1.765, while boys recorded higher values in general coordination (MA = 594.63 for boys and MA = 537.73 for girls), t(109) = 2.170, Sig. < 0.05, mean difference = 21.375. The results confirm previous research indicating that gender affects balance and general coordination.

Keywords*: static balance, general coordination, middle school students*

Introducere

Balance plays an important role in enhancing general coordination within physical education, particularly among children. Developing balance is essential for improving motor skills that are crucial for effective participation in physical activities. Research indicates that specific exercises can significantly improve balance and coordination, leading to better physical performance and increased engagement in physical education.

Studies have shown that specific exercises, such as the "Classic" exercise, can improve both balance and coordination in students. When integrated into the physical education curriculum, these exercises lead to significant improvements in coordination and balance among younger students (Polevoy, 2020).

Balance is a fundamental psychomotor component which, when optimized, enhances motor abilities. This improvement is crucial for daily activities and encourages children to engage in non-sedentary behaviors, thereby promoting better physical performance (Puta et al., 2022).

Research involving specific physical training programs, such as those used in judo, indicates that although these programs may improve motor coordination, they may not always significantly improve balance. This suggests that although balance and coordination are correlated, they may require distinct training approaches (Pereira, 2003).

For younger children, movement education models based on coordination have been shown to positively affect motor balance abilities, suggesting that early intervention can be beneficial in developing these skills (Esen et al., 2023).

In older children, specific exercises targeting improvements in static and dynamic balance have been shown to significantly enhance coordination behavior, underscoring the importance of age-appropriate exercises in physical education (Kochanowicz & Kucharska, 2010).

In older adults, balance and coordination exercises not only improve physical performance but also enhance cognitive functions. This indicates broader impacts of balance training beyond physical coordination, suggesting potential cognitive benefits for children as well (Muntianitė et al., 2016).

For children with hearing impairment, balance training has been shown to improve not only balance and motor coordination but also attention, highlighting the multiple benefits of balance exercises, particularly for children with specific needs (Hedayatjoo et al., 2020).

The purpose of this study was to determine whether gender differences exist in the level of motor indices, static balance, and general coordination. We consider that this research will

strengthen the scientific basis in the field and provide useful information for practitioners.

Materials and Methods

Participants

The study was conducted between April and June 2025 at "Grigore Ghica Voievod" Lower Secondary School in Suceava.

The research subjects were middle school students enrolled at this school.

Motor parameters were evaluated in all middle school students (grades 5–8), 111 students (44 girls and 67 boys).

The subjects were of different ethnicities and religions. They and their parents or legal guardians provided informed consent to participate in the research.

Testing was carried out in the school gym during physical education classes.

Procedure

a. Static balance – Flamingo Test

The Flamingo Test is a component of the Eurofit test battery designed to evaluate balance and physical fitness. It focuses on assessing an individual's ability to maintain balance on one leg, mimicking the posture of a flamingo.

It is widely used due to its simplicity, low cost, and applicability for mass testing across different age groups and populations.

The test is part of the broader Eurofit battery, which includes other measures of physical fitness such as flexibility, strength, and endurance.

The Flamingo Test is often used in educational and sports settings to assess balance and postural stability.

Description of test:

The subject stands on one leg, bending the free leg backward and holding the foot with the hand on the same side, resembling the position of a flamingo. The objective is to maintain this position for as long as possible without losing balance (Barabas et al., 1996).

b. General coordination – Matorin Test

„The Matorin Test" is a method used to assess general coordination in students, focusing particularly on motor abilities. This test is part of broader efforts to evaluate motor coordination, which is crucial for physical education and students' general development. Together with other coordination assessments, the Matorin Test provides insights into students' physical capacities and their potential impact on academic performance.

Description of test:

A circle with a diameter of 40 cm is drawn on the floor. The athlete stands inside the circle with the feet on either side of the diameter. The subject performs a vertical jump with rotation around the body's longitudinal axis. The test is performed twice, to the left and to the right. The number of degrees is measured. If the athlete lands outside the circle, the test may be repeated once.

Data analysis

Statistical analysis of the collected data was performed using SPSS v.26.0.

RESULTS

To test the hypothesis that gender differences may exist in the level of motor indices, static balance, and general coordination, several statistical tools were employed: the Kolmogorov–Smirnov test (Table 1) to verify the normality of data distribution, descriptive statistics to determine the mean values for motor tests for both genders (Table 2), the Independent Samples t-test to identify gender-based differences in means for motor indices, and Welch's test (Table 3).

Table 1. Kolmogorov–Smirnov and Shapiro–Wilk values for motor tests

Items	Gender	Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Static balance	Female	,099	44	,200*	,966	44	,212
	Male	,104	67	,070	,968	67	,077
Total coordination	Female	,135	44	,042	,936	44	,016
	Male	,115	67	,028	,944	67	,004

The Kolmogorov–Smirnov test results show that only the variable Static balance exhibited a normal distribution (Sig. > 0.05) in both groups. For the variable Total coordination, the normality assumption was not met.

Table 2. Mean values of motor indices by gender

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Static balance	Male	67	**18,54**	4,050	,495
	Female	44	**16,77**	4,398	,663
Total coordination	Male	67	**594,63**	108,374	13,240
	Female	44	**537,73**	112,841	17,011

Despite the Kolmogorov–Smirnov test indicating that the normality assumption was not fully satisfied, we decided to apply the Independent Samples t-test, given its robustness to violations of normality. Welch's test was also used as it is similarly robust to non-normal distributions.

Levene's test indicated homogeneity of variances in both groups (Sig. > 0.05). The means differed significantly by gender, as shown by the Student t-test (Sig. < 0.05).

For Static balance, variances were equal (Sig. = 0.485 > 0.05). The means differed significantly by gender (MA = 18.54 for boys and MA = 16.77 for girls), t(109) = 2.170, Sig. < 0.05, mean difference = 1.765; the 95% confidence interval for the difference between boys and girls was 0.153–3.376.

For Total coordination, variances were equal (Sig. = 0.483 > 0.05). The means differed significantly by gender (MA = 594.63 for boys and MA = 537.73 for girls), t(109) = 2.662, Sig. < 0.05, mean difference = 56.900; the 95% confidence interval for the difference between boys and girls was 14.534–99.265.

Table 3. Independent Samples t-test results for motor indices by gender

Items		**Levene's Test** for Equality of Variances		**t-test for Equality of Means**						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Static balance	Equal variances assumed	,491	,485	**2,170**	**109**	**,032**	**1,765**	**,813**	**,153**	**3,376**
	Equal variances not assumed			2,133	86,712	,036	1,765	,827	,120	3,409
Total coordination	Equal variances assumed	,494	,483	**2,662**	**109**	**,009**	**56,900**	**21,375**	**14,534**	**99,265**
	Equal variances not assumed			2,640	89,481	,010	56,900	21,557	14,070	99,729

Discussion

Gender differences in static balance and general coordination have been a subject of interest in various studies, with mixed results. Research indicates that gender can influence balance abilities, but the magnitude and nature of this influence vary across age groups and contexts. Generally, girls tend to outperform boys in static balance tasks, while dynamic balance and coordination show greater variability in gender differences.

Spatio-temporal orientation and balance capacity at certain ages demonstrate the superiority of one gender with respect to recorded performance levels.

These are the conclusions of a study investigating whether performance in spatio-temporal orientation and balance differs by gender. To determine sex differences, an analysis was performed on a sample of 120 primary school pupils divided by gender into two groups: 58 girls (M=27.13, SD=6.50 kg; M=129.07, SD=6.58 cm) and 62 boys (M=29.39, SD=7.90 kg; M=130.92, SD=7.02 cm).

The Matorin and Flamingo tests were applied. Independent samples t-tests were used to interpret the results. According to the findings, for the Flamingo Test – dominant leg, girls' values (M=4.48, SD=4.21) were significantly higher

(t=2.21, DF=118, two-tailed, p=0.028) than boys' values (M=3.06, SD=2.62). For the Matorin Test – skill component, boys' values (M=283.06, SD=82.04) were significantly higher (t=3.50, DF=118, two-tailed, p=0.001) than girls' values (M=232.55, SD=75.35). It is recommended to develop spatio-temporal orientation and balance skills, as these play a considerable role in technical sports and games where they are in high demand.

In preschool and primary school children, studies show that girls outperform boys in static balance tasks. For example, among preschoolers, girls demonstrated better performance on static balance tests such as one-leg stance and tandem position (Li et al., 2022). Similarly, primary school girls showed superior static balance on the MABC-2 static test (Rodríguez-Negro & Yanci, 2018).

Among adolescents, girls performed better on static balance tasks such as one-leg stance (Valtr et al., 2016). In young adults, no significant gender differences were found in static balance when assessed using the single-leg stance test (Hanafy, 2018).

In preschoolers, girls generally performed better on dynamic balance tests, except on the balance beam test where no significant gender difference was observed (Li et al., 2022). Among primary school pupils, no significant gender differences were found on dynamic balance tests (Rodríguez-Negro & Yanci, 2018).

Among adolescents, boys outperformed girls on tasks requiring object control, such as aiming and catching, which are components of dynamic coordination (Valtr et al., 2016).

Some studies suggest that gender differences in balance are not direct but mediated by factors such as muscle strength and maturational development (Azkiya et al., 2023). Regular physical activity is associated with better static balance in both girls and boys, suggesting that lifestyle factors can influence balance capacities (Zhu et al., 2021). Anthropometric factors and footwear may also affect balance, with women generally outperforming men in static balance tasks regardless of these variables (Jones et al., 2024).

Although gender differences in balance and coordination are evident, they are not uniform across all age groups and contexts. Factors such as muscle strength, physical activity, and anthropometry play significant roles in mediating these differences. In addition, the type of balance task (static vs. dynamic) and the specific age group studied may lead to varied results. Therefore, while sex may influence balance, it is essential to consider these other factors for a comprehensive understanding.

Conclusions

The results of the study show that middle school girls record higher values than boys in static balance, whereas boys record higher values than girls in general coordination.

Although our findings confirm previous research showing that gender affects balance and general coordination, future studies could explore the extent to which participant gender may influence the outcomes of intervention programs aimed at improving balance and general coordination in middle school students.

AUTHOR CONTRIBUTIONS

Author 1 and author 2 contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript. All authors have read and agreed to the published version of the manuscript.

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