

# Gender Differences in Motor Competence among Preschool Children: Evidence from the KTK Test

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## Abstract

This cross-sectional study aimed to determine the level of motor competence in preschool children and to identify differences between boys and girls. The sample consisted of 94 preschool children, categorized by gender: 41 boys (mean age 6.25±0.29 years; height 119.17±5.16 cm; body mass 21.96±2.55 kg) and 53 girls (mean age 6.23±0.28 years; height 119.32±5.91 cm; body mass 21.99±3.98 kg). To assess motor competence, the Body Coordination Test for Children (Körperkoordinationstest für Kinder; KTK) was used. The KTK consists of four motor subtests: Balancing Backwards, Moving Sideways, Hopping for Height, and Sideways Jumping. The raw scores of the four KTK tasks were converted into standardized Motor Quotient (MQ) scores using age- and sex-specific norms. MQ scores were then used to determine motor performance categories: Poor (1), Noticeable (2), Normal (3), Good (4), and High (5). Based on the t-test, boys achieved a significantly higher score in the Hopping for Height test (109.80 vs. 95.53,  $p=0.000$ ), while no differences were observed between the groups in the other three tasks. Boys also scored higher than girls on the Total Grade (2.93 vs. 2.62,  $p=0.028$ ), with both groups demonstrating, on average, normal motor performance. These findings suggest that there are some differences in motor competence between preschool boys and girls. However, further research with a larger sample is needed to generalize these results. Also, the findings suggest that children generally follow normal motor development; it is recommended to regularly conduct such assessments to identify weaker performance in individual children, which may indicate motor difficulties. This allows children to be promptly directed to appropriate interventions aimed at addressing and preventing motor impairments.

**Keywords:** *body coordination, motor abilities, motor development, Körperkoordinationstest für Kinder (KTK), preschoolers*

## Introduction

Interest in the assessment of children's motor status has increased significantly over the past two decades, resulting in a growing number of studies focusing on various aspects of motor development (Banjević et al., 2022; Chen, Song, Zhao, Lou, & Luo, 2023; Katanić, Veljković, Radaković, Mujanović, & Prvulović, 2025; Logan, Robinson, & Getchell, 2011; Song, Lau, & Wang, 2022). Within overall motor status, motor coordination is recognized as one of its key components, as it

represents the foundation for efficient, harmonious, and economical movement performance. Due to its crucial role in overall motor functioning and the development of more complex motor skills, research interest in the assessment of motor coordination has continued to rise (Silva, 2025). These studies emphasize the multifaceted importance of evaluating motor coordination, ranging from the early detection of motor developmental disorders, through the identification of sporting talent (O'Brien-Smith et al., 2019), to highlighting that better motor coordination has proven to be a more significant factor in

the development of appropriate body mass over time compared to physical activity or aerobic fitness (Martins et al., 2010).

Consequently, motor competence has become an increasingly important field of research, particularly among children and adolescents, taking into account the complexity of biological, sociological, and demographic factors and their mutual influence on motor development during childhood (Lopes et al., 2020). In this context, previous studies indicate that participation in a greater number of sports programs from preschool age (Fransen et al., 2012), as well as the quality of social support and the environment (Prätorius & Milani, 2004), positively influence the level of motor coordination.

Encouraging the development of motor coordination from preschool age may have long-term positive effects on children's health-related fitness (Stojiljković et al., 2024); however, the results of longitudinal studies have not established an association between early fundamental motor skills in preschool age and later levels of physical activity during adolescence (McKenzie et al., 2002). On the other hand, research findings suggest that the level of motor coordination is an important predictor of physical activity in children aged 6 to 10 years (Haugen & Johansen, 2018; Lopes et al., 2011).

The results of longitudinal studies indicate a negative trend of declining motor coordination levels with increasing age during the early school period (Šrkar et al., 2020), which further emphasizes the importance of identifying early patterns of motor competence already in preschool age. Documenting the findings of contemporary studies reveals a trend of low motor coordination levels among children aged 5–7 years; as many as 57.8% of Brazilian children from socially disadvantaged families exhibit motor coordination disorders according to KTK normograms (Oliveira, 2025). Conversely, 40.6% of participants involved in sports programs achieve above-average results (Söğüt, 2016). These findings are further supported by studies indicating that engagement in physical activity predicts better levels of motor coordination and BMI compared to inactivity (Biino et al., 2023).

Research also indicates that even preschool-aged children do not meet the recommended minimum levels of physical activity (Bornstein et al., 2011; Cardon & Bourdeaudhuij, 2008; Mancini et al., 2025). However, some studies report

positive trends, showing that the majority of preschool children meet international guidelines for physical activity (Jurado-Castro et al., 2025). The KTK test battery has been validated for use in preschool-aged children (Bardid et al., 2014). Preschool children in Serbia predominantly exhibit sedentary behavioral patterns during their stay in kindergarten and do not meet the recommended physical activity guidelines (Jančković et al., 2021).

Over the past few decades, awareness of the importance of early interventions has been increasing in our country; therefore, the justification for applying the KTK test battery in preschool institutions has been emphasized. This test battery has been widely used in various European countries over the past several decades, both among typically developing children and children with motor developmental disorders; however, it relies on outdated normative values, which may limit the interpretation of results (Iivonen et al., 2016).

Therefore, the aim of this study was to examine the level of motor competence in preschool-aged children and to detect potential sex differences, thereby contributing to a better understanding of motor competence in this age group.

## Methods

### Participants

The sample consisted of 94 preschool children attending the “My Childhood” Preschool Institution in Čačak, Serbia. For the purposes of this study, the children were categorized by gender, with 41 boys and 53 girls. The boys had an average age of  $6.25 \pm 0.29$  years, with an average height of  $119.17 \pm 5.16$  cm and an average body mass of  $21.96 \pm 2.55$  kg, and girls had an average age of  $6.23 \pm 0.28$  years, with an average height of  $119.32 \pm 5.91$  cm and an average body mass of  $21.99 \pm 3.98$  kg (Table 1).

The inclusion criteria were: healthy children of both sexes, enrolled in the older preschool group (aged 6 to 7 years), with no psychological or physical limitations. The study was approved by the pedagogical-educational institution, and written informed consent was obtained from the parents of all participating children, which is in accordance with the principles of the Helsinki Declaration (World Medical Association, 2011).

**Table 1.** Sample description

	Boys	Girls
Age	6.25±0.29	6.23±0.28
Body Height	119.17±5.16	119.32±5.91
Body Weight	21.96±2.55	21.99±3.98

Notes. The values are presented as arithmetic mean and standard deviation (mean ± SD).

### Procedures

The research was conducted at the “My Childhood” Preschool Institution in Čačak, Serbia, and the children were selected from three units of this institution. Measurements were carried out in November 2024. All assessments were conducted at the same time of day, starting at 10:00 a.m., to avoid daily fluctuations and to ensure the children's regular routines were

not disrupted. The investigation was carried out by two experienced examiners (B.K. and J.P.), both of whom hold doctoral degrees in physical education and have substantial experience in conducting such assessments. The assessment of anthropometric and motor parameters took approximately 15–20 minutes per child.

## Measurements

### Anthropometric characteristics

Anthropometric characteristics, such as body height and body mass, were assessed in accordance with the International Biological Program protocol (Eston & Reilly, 2013). Body height was measured using a stadiometer (SECA SE206, Hamburg, Germany) with a precision of 0.1 cm. The children were measured barefoot, standing with their backs against the wall, and their heads positioned in the Frankfurt plane. Body mass was assessed using a digital Tefal 6010 scale (Rumilly, Haute-Savoie, France) with an accuracy of 0.1 kg. The recorded values were documented and forwarded for further analysis.

### Motor competence

To assess motor competence, the Body Coordination Test for Children (Körperkoordinationstest für Kinder; KTK) was used (Kiphard, & Schilling, 2007). The KTK test has proven to be accurate and valid in assessing motor competence in preschool-aged children (Iivonen, Sääkslahti, & Laukkanen, 2016; Vandorpe et al., 2011). The KTK consists of four subtests: (1) walking backwards on a balance beam of decreasing width (Balancing Backwards); (2) moving sideways using wooden boards (Moving Sideways); (3) hopping for height by jumping over a foam obstacle on one leg (Hopping for Height); and (4) jumping sideways with both legs from side to

side (Sideways Jumping).

The raw results of these four KTK tasks are converted into standardized scores (MQ – Motor Quotient) using normative tables that take into account the child's age and sex. These standardized scores allow for the comparison of an individual's motor abilities with those of the reference population. Based on the obtained MQ score, the percentiles and corresponding categories of motor performance are determined, ranging from Poor (1), Noticeable (2), Normal (3), Good (4), to High (5) (Kiphard & Schilling, 2007).

### Statistics

The basic parameters of descriptive statistics were calculated, including the arithmetic mean and standard deviation. To examine potential differences in anthropometric characteristics and motor coordination between boys and girls, an independent samples t-test was employed, appropriate for comparisons between two groups. A significance level of  $p < 0.05$  was considered indicative of statistically meaningful results. All data analyses were conducted using SPSS version 26 (Statistical Package for the Social Sciences, v26.0, SPSS Inc., Chicago, IL, USA).

## Results

Table 2 presents the raw scores achieved in the motor tasks dividing to group of boys and girls preschool children.

**Table 2.** Descriptive raw score of KTK motor competence tasks

	Boys	Girls
Balancing Backwards	36.44±11.43	37.32±8.91
Hopping for Height	31.34±12.08	28.60±9.83
Sideways Jumping	39.49±11.53	39.89±9.23
Moving Sideways	15.98±3.52	16.42±2.47

Notes. The values are presented as arithmetic mean and standard deviation (mean ± SD).

Table 3 presents the standard scores for all four tests for both boys and girls. Based on the t-test, it was found that boys achieved a significantly higher score in the Hopping for Height test (109.80 vs. 95.53,  $p = 0.000$ ), while no differences between the groups were observed in the other three tasks.

After standardizing the given tests into the Sum of Mo-

tor Quotient Scores and the Total Motor Quotient, although boys showed higher values, the t-test indicated no significant difference. In contrast, for the Total Grade, boys achieved a significantly better result than girls (2.93 vs. 2.62,  $p = 0.028$ ), with both groups demonstrating, on average, good motor performance.

**Table 3.** Differences between boys and girls in KTK test performance; Standard score.

	Boys	Girls	t	p
Balancing Backwards	103.15±13.26	104.58±10.39	-0.590	0.557
Hopping for Height	109.80±12.35	95.53±16.69	4.588	0.000**
Sideways Jumping	110.73±15.79	107.42±16.15	0.997	0.321
Moving Sideways	64.44±6.57	66.25±7.03	-1.271	0.207
Sum of Motor Quotient Scores	388.12±37.46	373.77±41.42	1.736	0.086
Total Motor Quotient	96.10±12.13	91.40±13.35	1.761	0.082
Total Grade	2.93±0.57	2.62±0.71	2.240	0.028*

Notes. The values are presented as arithmetic mean and standard deviation (mean ± SD); t – t-value; p – p-value; \* –  $p < 0.05$ ; \*\* –  $p < 0.01$ .

## Discussion

This study aimed to determine the level of motor competence in preschool children and to identify differences between boys and girls. The main findings indicate that boys achieved a significantly higher score in the Hopping for Height test (109.80 vs. 95.53,  $p=0.000$ ), while no differences between the groups were observed in the other three tasks. It should also be noted that boys scored significantly higher than girls on the overall motor competence score (2.93 vs. 2.62,  $p=0.028$ ).

The obtained results indicating the superiority of boys in the Hopping for Height test are partially consistent with previous research. Specifically, a Belgian study (Vandorpe et al., 2011) reported better performance of boys in two tests—sideways jumping and hopping for height—as well as in the overall motor quotient (MQ). Similar findings were reported by another Belgian study conducted by Lima et al. (2017). Significant differences in three out of four subtests in favor of boys were also reported by Giuriato et al. (2021), while girls performed better in the balance assessment task, walking backwards on a balance beam. The superiority of boys in the Hopping for Height test was also confirmed in a study examining motor coordination in Finnish children (Laukkanen et al., 2017); however, this study did not identify significant differences in the overall motor quotient.

On the other hand, a considerable number of studies indicate that sex was not a significant predictor of overall motor coordination in preschool children (Catenassi et al., 2007; Gllareva et al., 2020; Marković, Katanić, & Peulić, 2025; Moreira, 2019; Sassu & Marcus, 2023; Ré et al., 2018). When observing the individual subtests of the KTK battery separately, numerous international studies report better performance of preschool girls in the balance task—walking backwards on a balance beam (D'Hondt et al., 2011; Giuriato et al., 2021; Karadeniz et al., 2024; Krombholz, 2006; Lima et al., 2017; Smits-Engelsman et al., 1998). Findings from previous studies conducted in Serbia on samples of preschool children also indicate superior performance of girls in the backward balance beam walking test (Đurović et al., 2025; Pelešić et al., 2024). Observing raw KTK scores in children aged 5–7 years, boys achieved better results in all four subtests as well as in the overall MQ (Oliveira et al., 2025). Better overall MQ results for boys were also reported in two studies from Denmark (Lima et al., 2017; Olesen et al., 2014).

It should be noted that the age range of children in many studies included for comparative analysis often encompassed early school-aged children (6–12 years), as in the study by Vandorpe et al. (2011). In contrast, some studies analyzed children aged 5–7 years as a separate category (Laukkanen et al., 2017). This should be taken into consideration when comparing results with studies that focused exclusively on preschool-aged children.

The results obtained in this study are consistent with previous research indicating that preschool boys perform better in tests assessing explosive strength and dynamic movements (Li et al., 2024; Martins et al., 2024; Yip et al., 2024), while sex differences at this age remain task-specific and not yet fully differentiated.

Previous studies (Cools et al., 2009; Ribeiro et al., 2012)

point to the outdated nature of the original normative tables used in the KTK battery, which were also applied in this study. This may represent an additional limitation, along with the small sample size and the relatively narrow geographical area from which the participants were recruited. Therefore, the development of national normative data in different countries—taking into account biological, social, economic, and cultural differences relative to the local context in which the original norms were established—would represent a valuable strategy for gaining a more accurate insight into the level of motor coordination in prepubertal children assessed using the KTK test battery.

Differences in motor competence do not necessarily need to be explained exclusively by sex characteristics; they may also be influenced by socioeconomic status, which is reflected in access to participation in organized and structured sports activities supported by parental involvement (Krombholz, 2018). Moreover, a greater number of children from higher socioeconomic backgrounds are involved in sports clubs from preschool age (Krombholz, 2006).

Future research should include measurement instruments and test batteries that allow for a qualitative assessment of the motor space of preschool children, as well as tasks that evaluate manipulative skills involving ball handling. Considering that the KTK battery is applied across a wide age range (5–14 years), longitudinal research designs would provide an opportunity to gain deeper insight into the complex relationships between body composition, levels of physical activity, and motor competence.

## Conclusion

The inconsistent findings in previous studies indicate the need for further research to more precisely determine the influence of sex on motor coordination. Boys demonstrated better performance in the Hopping for Height test, while results in the other subtests showed similar sex patterns. Although differences were observed in specific tasks, they do not fully explain the variability in motor competence, which is influenced by a larger number of exogenous factors, such as socioeconomic and cultural background, as well as the level of participation in sports activities. The relatively small sample size and narrow geographical area limit the generalizability of the results. Further research is needed both to enhance early intervention programs and to identify children with potential for sporting achievements.

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### Conflict of interest

The authors declare no conflicts of interest.

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