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DETERMINANTS OF MOTOR COMPETENCE IN CHILDREN: ASSOCIATIONS WITH SOCIODEMOGRAPHIC, ANTHROPOMETRIC, AND BODY COMPOSITION FACTORS

DETERMINANTES DA COMPETÊNCIA MOTORA EM CRIANÇAS: ASSOCIAÇÕES COM FATORES SOCIODEMOGRÁFICOS, ANTROPOMÉTRICOS E DE COMPOSIÇÃO CORPORAL

DETERMINANTES DE LA COMPETENCIA MOTORA EN NIÑOS: ASOCIACIONES CON FACTORES SOCIODEMOGRÁFICOS, ANTROPOMÉTRICOS Y DE COMPOSICIÓN CORPORAL

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Abstract

Motor competence (MC) can be defined as the level of skilled performance in different motor tasks. However, the influence of variables related to body composition and anthropometric measures has not yet been fully clarified. Therefore, the aim of this study was to evaluate the association between MC and sociodemographic, biological, and physical activity factors in children. This cross-sectional study was conducted with 172 children of both sexes, aged 6 to 10 years, from a municipal school.

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Motor competence was assessed using the Körperkoordinationstest für Kinder (KTK). Height, weight, waist circumference, leg length, foot length, and wingspan were measured. Body Mass Index (BMI) and waist-to-height ratio (WHtR) were calculated. Body composition was assessed by bioelectrical impedance analysis, providing body fat percentage, fat mass, and muscle mass. Bivariate and multivariate analyses were performed using Multiple Correspondence Analysis (MCA) and Multiple Linear Regression, with a significance level of 5%. The mean MC score was 42.66 (± 10.97) points. Significant associations were observed with age, body fat percentage, WHtR, leg length, wingspan, and participation in extracurricular physical activity. MCA indicated a moderate association between higher MC, older age, adequate body fat percentage, and physical activity practice. Multiple regression analysis demonstrated positive associations of MC with age, BMI, and wingspan, and negative associations with body fat percentage and waist circumference. It is concluded that motor competence shows independent associations with biological factors, especially age, wingspan, and body composition indicators. These findings reinforce the need for multifactorial approaches in the assessment and intervention of motor competence in children, considering sociodemographic, biological, and behavioral aspects.

Keywords: Motor competence; children; Physical activity level.

Resumo

A competência motora (CM) pode ser definida como o grau de desempenho habilidoso em diferentes tarefas motoras. No entanto, a influência de variáveis relacionadas à composição corporal e às medidas antropométricas ainda não está totalmente esclarecida. Assim, o objetivo deste estudo foi avaliar a associação da CM com fatores sociodemográficos, biológicos e com a prática de atividade física em crianças. Trata-se de um estudo transversal, realizado com 172 crianças de ambos os sexos, com idades entre 6 e 10 anos de uma escola municipal. A CM foi avaliada por meio do Teste de Coordenação Corporal para Crianças (KTK). Foram mensurados estatura, peso, perímetro da cintura, comprimento da perna, comprimento do pé e envergadura. O Índice de Massa Corporal (IMC) e a relação cintura-estatura (RCE) foram calculados. A composição corporal foi avaliada por bioimpedância elétrica, obtendo-se percentual de gordura, massa de gordura e massa muscular. Foram realizadas análises bivariadas e multivariadas, utilizando Análise de Correspondência Múltipla (ACM) e Regressão Linear Múltipla, com nível de significância de 5%. A CM média foi de 42,66 (± 10,97) pontos. Observou-se associação significativa com idade, percentual de gordura, RCE, comprimento da perna, envergadura e prática de atividade física extraescolar. A ACM indicou associação moderada entre maior CM, idade mais elevada, percentual de gordura adequado e prática de atividade física. A regressão múltipla demonstrou associação positiva da CM com idade, IMC e envergadura, e associação negativa com percentual de gordura e perímetro da cintura. Conclui-se que a competência motora apresenta associação independente com fatores biológicos, especialmente idade, envergadura e indicadores

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da composição corporal. Esses resultados reforçam a necessidade de abordagens multifatoriais na avaliação e intervenção da CM em crianças, considerando aspectos sociodemográficos, biológicos e comportamentais.
Palavras-chave**:** Competência motora; crianças; nível de atividade física.

Resumen

La competencia motora (CM) puede definirse como el grado de desempeño habilidoso en diferentes tareas motoras. Sin embargo, la influencia de variables relacionadas con la composición corporal y las medidas antropométricas aún no está completamente esclarecida. Por lo tanto, el objetivo de este estudio fue evaluar la asociación entre la CM y factores sociodemográficos, biológicos y la práctica de actividad física en niños. Se trata de un estudio transversal, realizado con 172 niños de ambos sexos, con edades entre 6 y 10 años, pertenecientes a una escuela municipal. La CM fue evaluada mediante el Test de Coordinación Corporal para Niños (KTK). Se midieron la estatura, el peso, el perímetro de la cintura, la longitud de la pierna, la longitud del pie y la envergadura. Se calcularon el Índice de Masa Corporal (IMC) y la relación cintura-estatura (RCE). La composición corporal fue evaluada mediante bioimpedancia eléctrica, obteniéndose el porcentaje de grasa corporal, la masa grasa y la masa muscular. Se realizaron análisis bivariados y multivariados utilizando Análisis de Correspondencia Múltiple (ACM) y Regresión Lineal Múltiple, con un nivel de significancia del 5%. La CM media fue de 42,66 (± 10,97) puntos. Se observó una asociación significativa con la edad, el porcentaje de grasa corporal, la RCE, la longitud de la pierna, la envergadura y la práctica de actividad física extraescolar. El ACM indicó una asociación moderada entre mayor CM, mayor edad, porcentaje adecuado de grasa corporal y práctica de actividad física. El análisis de regresión múltiple demostró una asociación positiva de la CM con la edad, el IMC y la envergadura, y una asociación negativa con el porcentaje de grasa corporal y el perímetro de la cintura. Se concluye que la competencia motora presenta asociaciones independientes con factores biológicos, especialmente la edad, la envergadura y los indicadores de composición corporal. Estos resultados refuerzan la necesidad de enfoques multifactoriales en la evaluación e intervención de la CM en niños, considerando aspectos sociodemográficos, biológicos y conductuales.
Palabras clave: Competencia motora; niños; nivel de actividad física.

1. Introduction

Motor competence (MC) refers to a child's capability to execute a variety of movement skills with proficiency, playing a central role in the development of physical activity behavior, health, and overall well-being (STODDEN et al., 2008; CATTUZZO et al., 2014). Fundamental movement skills (FMS) include locomotor

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actions such as running and jumping, and object control tasks such as throwing and catching, which serve as the foundation for participation in sport and physical activity (GALLAHUE; OZMUN; GOODWAY, 2013).

Accurate assessment of MC is essential, as differences in both assessment type and developmental stage may influence the interpretation of motor performance outcomes (SILVA, 2025). Basic instruments include the Test of Gross Motor Development–second edition (TGMD-2) and the Körperkoordinationstest für Kinder (KTK), which focus on process- and product-oriented outcomes, respectively (ULRICH, 2000; MOREIRA, 2016). MC development and performance are influenced by a combination of sociodemographic, biological, and behavioral factors. Age and sex continue to emerge as consistent correlates of MC in school-aged children (PLATVOET et al., 2016; ŠEFLOVÁ, 2025).

Emerging evidence also suggests that body composition, particularly excess body fat, may constrain motor skill proficiency, highlighting the need to incorporate measures beyond body mass index (BMI) in motor competence research (WEBSTER et al., 2021; REBELO et al., 2025). A recent study in Portugal reported that poorer body composition profiles were associated with lower MC and tended to worsen across school years, reinforcing the link between body fatness and motor performance (REBELO et al., 2025). Furthermore, differential associations between MC and academic achievement have also been observed, suggesting potential cross-domain effects of motor proficiency on child development outcomes (MOON et al., 2024).

Behavioral factors, such as participation in extracurricular physical activity and overall physical activity levels, are frequently associated with higher MC scores and better health outcomes (SPRING et al., 2023). Current research emphasizes how PA and MC may mutually reinforce each other, where higher motor skill competence predicts greater physical activity engagement and vice versa, which may impact lifelong behaviors and health trajectories.

In summary, integrating recent evidence with classic models underscores the multifactorial determinants of motor competence in children. A comprehensive

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understanding of how sociodemographic, biological, and behavioral factors interact is critical for developing effective intervention strategies aimed at improving motor development, physical activity, and health in pediatric populations. Thus, the objective of this study was to evaluate the association between motor competence and sociodemographic, biological, and extracurricular physical activity factors in children.

2. Materials and methods

Study Design, casuistic, and sample

This study was characterized as a cross-sectional census-based investigation. The research was conducted with 172 children of both sexes, aged between 6 and 10 years, regularly enrolled in elementary education (1st to 5th grade) in the municipal public school system of Tabuleiro, Minas Gerais, Brazil.

A census approach was adopted, as all students enrolled in the selected school who met the study’s inclusion criteria were invited to participate. This methodological strategy was chosen due to the relatively small and concentrated population, as well as the feasibility of obtaining specific data from each participant, which are typical characteristics of census studies (THOMAS; NELSON; SILVERMAN, 2011).

The statistical power of the study was calculated considering the prevalence of children with low motor competence, based on the classification of the New Motor Quotient proposed by Moreira (2016), and the number of children classified according to body weight status: normal weight (non-exposed, n = 159) and overweight/obese (exposed, n = 13), based on Body Mass Index criteria.

The sample size was estimated based on the expected difference in proportions between groups. Specifically, the proportion of children with low motor competence and overweight/obesity was estimated at 3%, whereas the proportion of eutrophic children with adequate motor competence was estimated at 1%. Considering these parameters, a significance level of 5% (two-sided test), and the total sample included in the study, the estimated statistical power was 81.88%. The calculation was performed using the StatCalc module of Epi Info™ (Centers for

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Disease Control and Prevention, Atlanta, USA).

Eligibility criteria and ethical considerations

Children were included in the study if they met the following criteria: being between 6 and 10 years of age, of both sexes, and having voluntarily agreed to participate, as confirmed by the signing of an informed consent form by their legal guardians. Children were excluded if they did not participate in all stages of data collection, presented physical or mental disabilities that prevented the performance of the motor competence assessment, or used a cardiac pacemaker.

This study was conducted in accordance with Resolution No. 466/12 of the Brazilian National Health Council and was approved by the Research Ethics Committee for Human Beings of the Federal University of Juiz de Fora (CEP/UFJF), under approval number 1,942,567 (CAAE: 62673916.0.0000.5147). All participants and their legal guardians were previously informed about the objectives and procedures of the study. Written informed consent was obtained from the legal guardians of all participants, authorizing their participation and the use of images for scientific purposes.

Data Collection Procedures

Data collection was conducted in a large, well-ventilated room suitable for performing the assessment procedures. Anthropometric measurements and bioelectrical impedance analysis were carried out by a researcher with experience in physical measurements and evaluations, who also underwent specific training during the pilot study phase.

For the administration of the KTK, the researcher was assisted by four undergraduate students from the Physical Education Teacher Education Program at the Federal Institute of Education, Science and Technology of Southeast Minas Gerais (IF Sudeste), Rio Pomba campus, Brazil. All assistants participated in a training program conducted by the principal investigator prior to data collection.

During this training, the materials and standardized procedures were presented, with emphasis on the most common application errors. Detailed instructions were provided, and all questions were addressed. As part of the training

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process, the students were required to administer the test under the supervision of the researcher, aiming to ensure confidence, methodological consistency, and the prevention of possible errors or data inconsistencies during the assessment. The data collection procedures are illustrated in Figure 1.

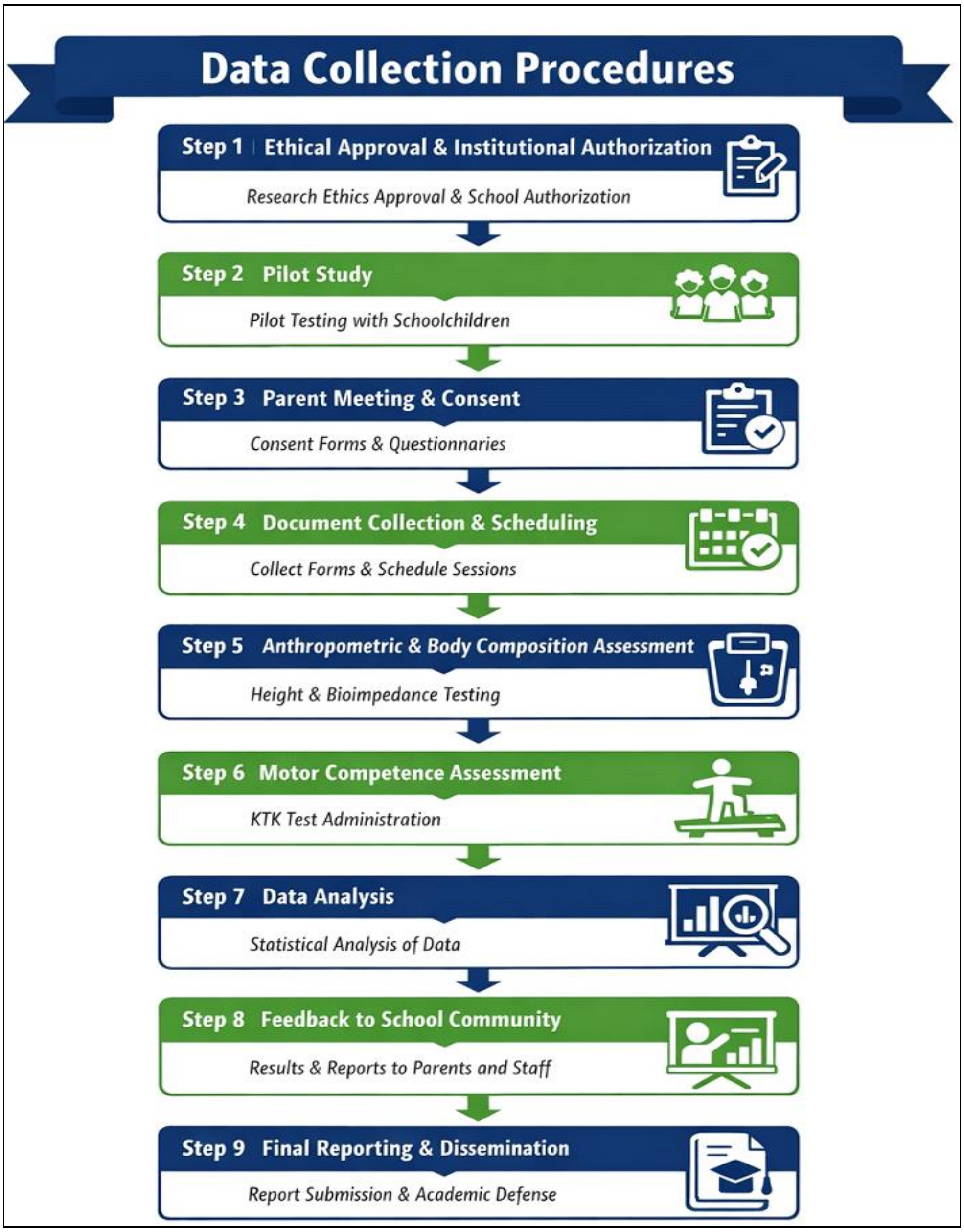

Figure 1: Flowchart of the Data Collection Procedures.

KTK Scoring and Evaluation Procedures

There are different methods for analyzing performance in the KTK. The first

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method consists of calculating the raw total score by summing the points obtained in the four test tasks (PETROSKI; TAGLIARI, 2026). Another approach involves transforming the scores obtained in each task into Motor Quotients (MQ), according to the normative tables of the original study, based on sex and age, which allows a qualitative assessment of motor competence. By adding the values obtained in each of the four tasks, the General Motor Quotient (GMQ) is obtained, as proposed by Kiphard and Schilling (1974). The third method for calculating KTK scores, which was adopted in the present study, was proposed by Moreira (2016). This approach was chosen because it offers advantages compared to other evaluation methods. According to Moreira (2016), the modification of the mathematical equation enhances the relative contribution of each task to the final test score. In addition, this method allows comparisons between different groups based on the combined results of the four tasks, which is not possible using traditional scoring approaches. The equation proposed by Moreira (2016) is: $NQM = (0.279 \times ET) + (0.305 \times SL) + (0.295 \times TL) + (0.301 \times SM)$. Where ET, SL, TL, and SM correspond to the scores obtained in each of the four test tasks.

Sociodemographic Factors

The sociodemographic variables assessed in this study included age, sex, and socioeconomic status. Information on age, sex, and parental education level was obtained using a sociocultural questionnaire. Socioeconomic status was determined using the Brazilian Economic Classification Criterion developed by the Brazilian Association of Research Companies (ABEP), 2016 version, which estimates household purchasing power.

Biological factors

Anthropometric measurements were performed by a single trained researcher and recorded on individual assessment forms. The following variables were measured: standing height, sitting height, leg length, foot length, wingspan, and waist circumference.

Standing height was measured twice using a portable stadiometer (Cescorf®), with millimeter precision and a maximum height of 2.20 m. Children stood barefoot in an upright position with heels, gluteal region, back, and head

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aligned against the vertical surface. Measurements were recorded during brief respiratory apnea (Charro et al., 2010).

Sitting height was measured using the same stadiometer attached to a 50 cm bench. Children were seated with their backs against the measuring device and hips and knees flexed at 90°, and measurements were taken during inspiratory apnea (Charro et al., 2010).

Leg length and foot length were measured using a flexible metallic tape (Cescorf®). Leg length was obtained from the anterior inferior iliac spine to the plantar surface of the left foot, with the participant standing and weight evenly distributed. Foot length was measured from the heel to the tip of the longest toe.

Waist circumference was measured twice at the midpoint between the lowest rib and the iliac crest, and the mean value was recorded. Classification was based on the 90th percentile for sex-specific reference values (Charro et al., 2010).

Wingspan was measured with the child standing and arms extended horizontally, considering the distance between the tips of the middle fingers (Charro et al., 2010).

Nutritional status was assessed using Body Mass Index (BMI), calculated as body weight (kg) divided by height squared (m^2). BMI-for-age z-scores were determined according to World Health Organization reference standards for children and adolescents aged 5 to 19 years (De Onis et al., 2007), and participants were classified as underweight, normal weight, overweight, or obese.

The waist-to-height ratio (WHtR) was calculated by dividing waist circumference (cm) by height (cm). Abdominal obesity was defined as WHtR ≥ 0.50, regardless of age and sex (Ashwell; Gibson, 2014).

Body composition was assessed using vertical bioelectrical impedance analysis with eight tactile electrodes (InBody 120®, Biospace Co., Korea). To ensure measurement reliability, participants were instructed to avoid vigorous physical activity for 24 hours prior to assessment, refrain from using diuretic medications for seven days, and urinate at least 30 minutes before testing. Children were evaluated barefoot, wearing light clothing, and without metallic accessories.

Basic personal data were entered into the device prior to assessment.

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Participants stood on the platform with clean, dry feet and held the hand electrodes according to manufacturer instructions. The analysis provided measurements of body weight, muscle mass, fat mass, and body fat percentage (InBody Manual, 2006).

Extracurricular Physical Activity

Information regarding extracurricular physical activity, including modality, duration of practice, weekly frequency, and session length, was obtained through the sociocultural questionnaire.

Data Analysis

Data were analyzed using bivariate and multivariate techniques to identify variables associated with children's motor competence. All analyses were performed using the Statistical Package for the Social Sciences (SPSS) for Windows, version 20.0 (IBM Corporation®, New York, USA). The level of significance was set at $\alpha = 0.05$ for all statistical tests.

Data normality was assessed using the Kolmogorov-Smirnov test, as well as skewness and kurtosis values. Mean or rank comparisons between two or more groups were selected according to data distribution. When the dependent variable showed a normal distribution, Student's t-test was applied, whereas the Mann–Whitney U test was used when normality was not observed. For variables with three or more categories and normal distribution, one-way analysis of variance (ANOVA) with Tukey's post hoc test was performed. When normality was not met, the Kruskal-Wallis test with Bonferroni post hoc correction was applied.

Correlations between continuous variables were examined using Spearman's correlation coefficient (rs). Associations between categorical variables were assessed using the chi-square (χ^2) test or Fisher's exact test, when appropriate.

Multiple Correspondence Analysis (MCA) was used to explore the dispersion and proximity of categorical variable classifications related to motor competence. Motor competence was categorized into four groups according to percentile values: low MC (≤ 35.0), moderately low MC (35.01–43.0), moderately high MC (43.01–51.0), and high MC (≥ 51.01). Graphical representations and dispersion patterns of

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dimensions 1 and 2 were analyzed to interpret the correspondences between variable classifications. Category proximity and internal consistency were evaluated using inertia values and Cronbach's alpha coefficients for each dimension.

Simple and multiple linear regression analyses were conducted to confirm factors associated with motor competence. Initially, independent variables with p-values ≤ 0.200 in simple linear regression were selected for inclusion in the multiple regression model using the backward method.

The multiple regression model was evaluated based on the statistical significance of the selected variables, and variables with p-values > 0.05 were removed. The overall significance of the final model was assessed using the F-test from analysis of variance, and model fit was evaluated using the adjusted coefficient of determination (adjusted R^2). Multicollinearity among independent variables was examined using the Variance Inflation Factor (VIF). Finally, residuals were analyzed according to assumptions of normality, homoscedasticity, linearity, and independence to ensure the quality and adequacy of the regression model.

4. Results

A total of 172 children were selected to participate in the study out of 276 students enrolled at the school. One hundred and four students were not included: 74 did not meet the investigated age range, 26 met at least one of the established exclusion criteria, and 4 declined to participate. The sample consisted of 86 boys and 86 girls, representing 50% of the participants in each sex. The children's ages ranged from 6 to 10 years, with approximately 10% of participants of each sex in each age group. Height and wingspan showed a normal distribution. The mean height was 131.1 cm (± 9.32 cm), and the mean wingspan was 130.9 cm (± 10.6 cm).

The median BMI was 17.0 kg/m² (25^{th}P: 15.1– 75^{th}P: 18.1 kg/m²), and the median body fat percentage was 22.9% (25^{th}P: 17.0 – 75^{th}P: 26.0%). More than half of the children, 113 (65.3%), reported not participating in any extracurricular physical activity programs. No significant associations were found between motor

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competence and sex or socioeconomic classification. However, children with higher body fat percentage ($p = 0.006$), higher waist-to-height ratio ($p < 0.001$), and shorter duration of extracurricular physical activity ($p = 0.007$) exhibited lower

Factors	Median	25thP – 75thP	*p-value*
BMI classification			
Eutrophic	45.0	35.7 – 51.0	0.478
Overweight	39.8	31.2 – 50.7	
Obesity	42.0	25.5 – 53.5	
BF%			
Low	45.0	42.0 – 48.0	0.006**
Adequate	45.0‡	38.0 – 53.0	
Slightly high	43.0	34.0 – 49.0	
High	35.0‡	25.0 – 45.0	
WC			
Adequate	44.0	35.0 – 51.0	0.287
High	39.0	25.5 – 53.5	
WHtR			
Adequate	44.0	36.0 – 51.0	<0.001*
High	26.0	23.0 – 29.0	
EPA			
Yes	48.0	34.0 – 49.0	0.007*
No	42.0	34.0 – 49.0	

motor competence (Table 1). No significant association was identified between motor competence and BMI or waist circumference.

Table 1 – Association between motor competence, body composition, and extracurricular physical activity practice.

*Significant p-value from the Mann–Whitney test.
**P-values from the Kruskal–Wallis test.
‡P-values ($p < 0.001$) lower than the post hoc significance level adjusted by Bonferroni correction ($\alpha = 0.0083$).
BF%: body fat percentage; WC: waist circumference; WHtR: waist-to-height ratio; EPA: Extracurricular physical activity.

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Source: Research data.

Based on the results of the Multiple Correspondence Analysis (MCA), dimensions 1 and 2 presented Cronbach's alpha values of 0.520 and 0.470, respectively, indicating moderate internal consistency among the categories. Together, these dimensions explained 66.6% of the total inertia, suggesting an adequate representation of the underlying structure of the data.

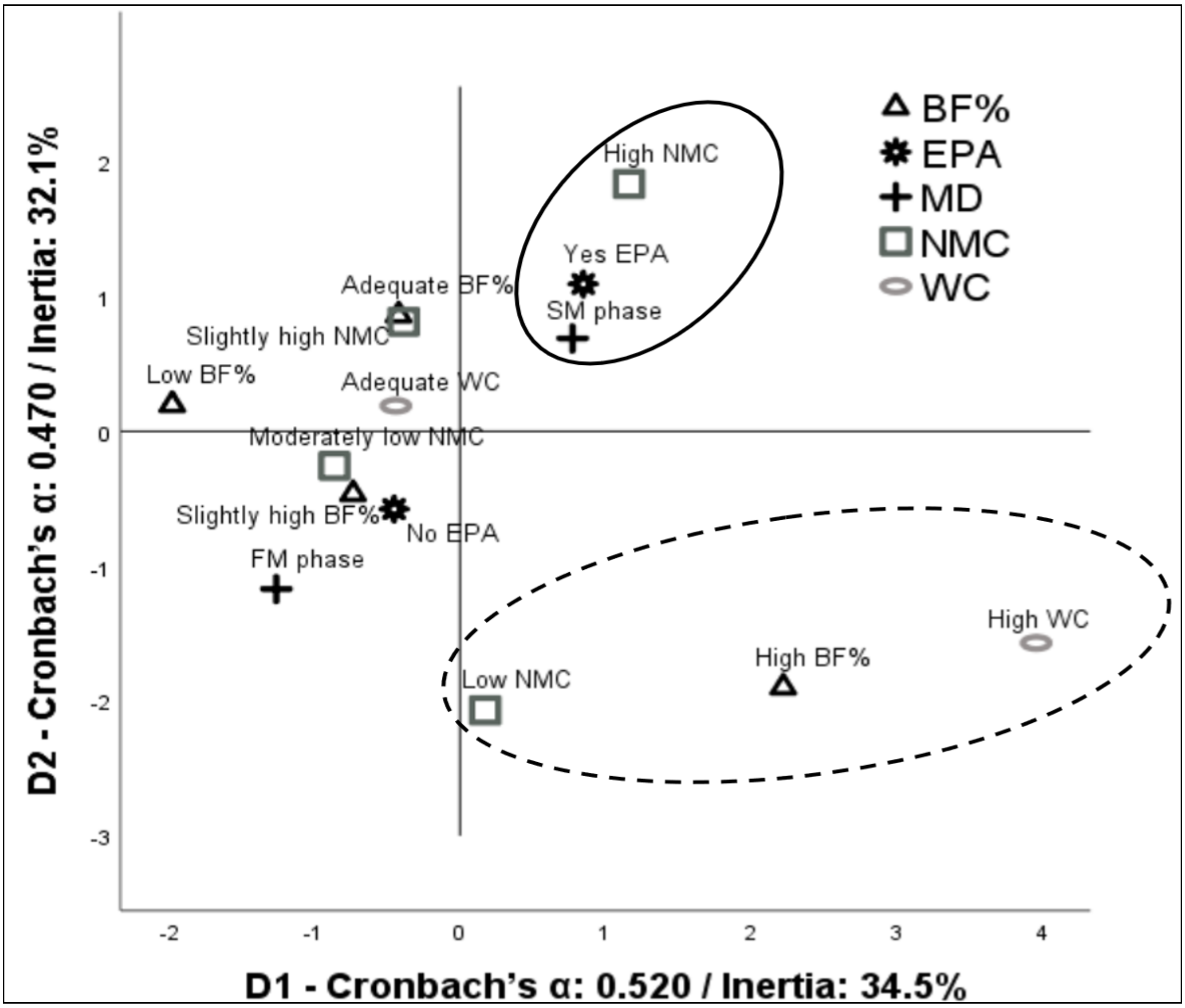

Figure 2: Multiple Correspondence Analysis between Motor Competence and Motor Development, Physical Activity Practice, and Body Composition.
BF%Ç Body fat percentage; EPA: Extracurricular physical activity; MD: Motor development; NMC: New Motor Competence score; WC: Waist circumference; D1: Dimension 1; D2: Dimension 2; FM phase: Fundamental movement phase; SM phase: Specialized movement phase.

Dimension 1 (D1) primarily reflected a gradient related to motor competence

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and physical activity engagement, contrasting children with high New Motor Competence scores, participation in extracurricular physical activity, and positioning in the specialized movement phase characterized by low motor competence and absence of structured physical activity. This dimension may therefore be interpreted as representing a functional and behavioral axis of motor development and engagement in physical activity.

Dimension 2 (D2), in turn, was mainly associated with body composition indicators, particularly body fat percentage and waist circumference. Higher values on this dimension were predominantly related to excess adiposity, whereas lower values were associated with adequate body fat levels. Thus, D2 can be interpreted as a morphological or adiposity-related axis.

In the perceptual map (Figure 2), children with high New Motor Competence scores were positioned closer to the categories representing adequate body fat percentage, participation in extracurricular physical activity, and age corresponding to the transition to the specialized movement phase. Conversely, low motor competence was spatially associated with high body fat percentage and increased waist circumference. Overall, the MCA revealed a clear multidimensional structure, in which motor competence is simultaneously influenced by behavioral factors (physical activity practice), developmental aspects (motor development phase), and morphological characteristics (body composition). These findings reinforce the interconnected nature of motor development, lifestyle behaviors, and adiposity in childhood.

The second multivariate analysis, Multiple Linear Regression, was performed to statistically confirm the association between independent factors and motor competence scores. Initially, the normal distribution of motor competence scores was confirmed by assessing kurtosis, skewness, and the p-value of the Kolmogorov-Smirnov normality test, which was 0.060. Simple linear regression analysis indicated that sex ($p = 0.679$) and foot length ($p = 0.336$) were not retained for the multivariate model, as they did not meet the inclusion criterion of $p \leq 0.200$, suggesting no significant association with the dependent variable (Table 2).

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Tabela 2: Simple Linear Regression Analysis of the Association between Motor Competence and Independent Variables

Factors	New Motor Competence score			
	β Coefficient	**95%CI**	***p-value***	**R^2**
Age (Years)	3.810	2.77 - 4.86	< 0.001*	0.235
Sex				
Boys	1			
Girls	- 0.689	- 4.02 - 2.62	0.679	0.001
EPA				
Yes	1			
No	-4.350	-7.81 - -0.91	0.013*	0.036
BMI	-0.682	-1.28 - -0.086	0.025*	0.024
BF%	-0.489	-0.70 - -0.27	< 0.001*	0.110
WC	-0.133	-0.368 - -0.021	<0.02*	0.110
Bone mass	1.330	0.71 - 1.94	< 0.001*	0.096
Foot length	0.205	-0.21 - 0.62	0.336	0.060
Leg length	0.420	0.22 - 0.61	< 0.001*	0.100
Wingspan	0.418	0.27 - 0.562	< 0.001*	0.164

* Variables with p-values lower than 0.200 selected for multivariate regression analysis
95%CI: Confidence interval; EPA: Extracurricular physical activity; BMI: Body mass index; WC: Waist circumference; BF%: Body fat percentage.Fonte: dados da pesquisa.
Source: Research data

In the final Multiple Linear Regression model, higher age, BMI, and wingspan were significantly associated with higher motor competence scores. For each one-unit increase in age and wingspan, motor competence increased by 3.26 and 0.224 points, respectively. On the other hand, for each increase in waist circumference (WC) and body fat percentage (BF%), MC decreased by 0.056 and 0.80 points, respectively (Table 3).

Table 3 - Multiple Linear Regression Model of Motor Competence and Associated Factors.

Factors‡	New Motor Competence score							
	β Coefficient	**95%CI**	***p-value****	**R^2**	**Adjusted R^2**	**F-test**	**Durbin-Watson**	**VIF**
	-	-	-	0.41	0.39	< 0.001	1.70	-
Age (Year)	3.26	1.75 - 4.77	< 0.001					2.68
Wingspan (cm)	0.224	0.013 - 0.43	0.031					3.05

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WC (cm)	- 0.56	- 0.99 - -0.14	0.023	2.83
BF%	- 0.80	- 0.14 - -0.46	<0.001	2.18

‡ Backward variable selection method
* Significant values ($p < 0.05$) of the independent variables in the model.
95%CI: Confidence interval; VIF: *variance inflation fator*; WC: Waist circumference; BF%: Body fat percentage.
Source: Research data.

Conversely, children with higher waist circumference and body fat percentage presented lower motor competence scores. Specifically, for each one-unit increase in WC and BF%, motor competence decreased by 0.560 and 0.800 points, respectively (Table 3).

5. Discussion

The findings highlight the multifactorial nature of motor competence development and reinforce the relevance of biological maturation, body composition, and physical activity engagement in childhood. The MCA revealed that high motor competence was more closely associated with adequate body fat percentage, participation in extracurricular physical activity, and age corresponding to the transition stage of the specialized motor phase.

Conversely, low motor competence was primarily related to elevated body fat percentage, increased waist circumference, and absence of physical activity. These findings are consistent with the developmental model proposed by Stodden et al. (2008), which emphasizes the reciprocal relationship between motor competence, physical activity, and health outcomes. According to this framework, children with higher motor competence are more likely to engage in physical activity, leading to better physical fitness and healthier body composition, whereas children with lower competence tend to adopt more sedentary behaviors.

Recent studies support this perspective. Den Uil et al. (2023) demonstrated that children with higher actual and perceived motor competence were more physically active and exhibited better fitness profiles. Similarly, Piotrowski et al. (2022) reported a global decline in fundamental movement skills, which may be partly explained by reduced opportunities for physical activity and increased sedentary behavior. These findings align with the present study, in which

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participation in extracurricular physical activity emerged as a relevant factor associated with higher motor competence.

An important methodological aspect to consider is the presence of physiological multicollinearity among adiposity indicators, particularly body fat percentage and waist circumference. Although these measures reflect different components of body composition - overall and central adiposity, respectively - they share common biological determinants and are therefore strongly correlated in pediatric populations. Their simultaneous association with low motor competence in the present study suggests that both indicators capture overlapping aspects of excess adiposity linked to impaired motor performance. This pattern reflects underlying pathophysiological mechanisms, whereby increased fat accumulation may compromise movement efficiency, postural control, and biomechanical alignment, while reduced motor competence may further limit physical activity participation, reinforcing adiposity in a bidirectional manner. Consequently, these indicators should be interpreted as complementary measures of a shared adiposity-related construct rather than as independent predictors, and future studies may benefit from using composite indices or latent variable approaches to minimize collinearity-related bias.

The multiple linear regression analysis confirmed the independent contribution of age, wingspan, waist circumference, and body fat percentage to motor competence scores. Age showed the strongest positive association, indicating that biological maturation and accumulated motor experience play an essential role in the development of motor proficiency. This result corroborates previous research demonstrating progressive improvements in motor competence across childhood (GALLAHUE; OZMUN; GOODWAY, 2013; MOSTAERT et al., 2016).

Wingspan also showed a positive association with motor competence, suggesting that body proportionality and linear growth may facilitate motor performance. Anthropometric dimensions such as limb length and wingspan may provide biomechanical advantages in balance, coordination, and locomotor tasks, particularly in product-oriented assessments such as the KTK (PETROSKI;

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TAGLIARI, 2026). Similar associations have been reported by Webster et al. (2021) and Moon et al. (2024), who observed that body structure variables significantly influenced motor skill performance.

In contrast, waist circumference and body fat percentage were negatively associated with motor competence. These findings indicate that excess adiposity represents an important barrier to motor performance in children. Higher fat mass increases mechanical load, reduces movement efficiency, and may limit participation in physical activities, thereby compromising motor development. Cattuzzo et al. (2014) reported that overweight and obese children consistently present lower motor competence levels, a pattern confirmed by more recent studies (SPRING et al., 2023; BAO et al., 2024).

The confirmation of negative associations between waist circumference, body fat percentage, and motor competence further reinforces the relevance of different body composition indicators for motor performance (MARMELEIRA et al., 2017). This finding is particularly important because most studies focus primarily on the influence of BMI on motor competence. Although BMI reflects the relationship between body mass and height, it does not distinguish between fat mass and lean mass components. In contrast, waist circumference and body fat percentage provide more specific and systematic assessments of adiposity, as waist circumference reflects central fat accumulation and body fat percentage quantifies total adipose tissue (ASHWELL; GIBSON, 2014; WEBSTER et al., 2021).

Interestingly, BMI showed a positive association with motor competence in the regression model, whereas body fat percentage and waist circumference were negatively associated. This finding suggests that BMI alone may not adequately reflect body composition in children, as increases in BMI may also reflect lean mass gains during growth. Therefore, the inclusion of more specific indicators of adiposity is essential for a more accurate interpretation of motor competence determinants.

These results indicate that excess adipose tissue, in addition to representing a major risk factor for cardiometabolic diseases, is also associated with reduced motor competence. Therefore, children with higher body fat accumulation tend to exhibit lower motor performance. Conversely, children with limited ability to perform

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gross and fine motor skills may be more susceptible to developing overweight and obesity, reinforcing the bidirectional relationship between motor competence and body composition (STODDEN et al., 2008; DEN UIL et al., 2023; MOON et al., 2024).

Some limitations of this study should be acknowledged. The cross-sectional design prevents causal inferences regarding the relationships among motor competence, physical activity, motor development, and adiposity. In addition, biological maturation was not directly assessed, and variations in pubertal timing may have influenced body composition, motor performance, and physical activity behaviors independently of chronological age. Physical activity was self-reported, which may be subject to recall and social desirability bias, and the inclusion of correlated adiposity indicators may have introduced collinearity effects. Therefore, longitudinal studies incorporating objective measures of physical activity and direct assessment of biological maturation are needed to better clarify the developmental pathways underlying these associations.

Another limitation concerns the exclusive use of KTK for motor competence assessment. Although the KTK is widely used and validated, it primarily evaluates balance and coordination-related motor tasks. The inclusion of complementary instruments, such as the Test of Gross Motor Development–Second Edition (TGMD-2), could have provided a broader assessment of locomotor and object control skills. However, its application requires specific training, experienced evaluators, and video-based analysis, which was not feasible within the time constraints of the present study.

The present findings also emphasize the importance of multivariate analytical approaches in motor competence research. Some variables, such as BMI, did not show significant associations in univariate analyses but became significant when analyzed jointly with other biological and behavioral factors. This result highlights the complexity of motor development and supports the use of multivariate models.

From a practical perspective, these findings highlight the need for early, multifactorial intervention strategies aimed at promoting motor development. School-based and community programs should emphasize diversified motor

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experiences, regular physical activity, and healthy lifestyle habits (SOUZA et al., 2023). Integrated motor skill and physical activity programs have been shown to be more effective in improving long-term health trajectories (BAO et al., 2024; DEN UIL et al., 2023).

5. Conclusion

In conclusion, motor competence in children is independently associated with age, body proportionality, body composition, and participation in extracurricular physical activity. These results support the adoption of multidisciplinary and developmentally appropriate strategies to promote motor competence, physical activity, and health during childhood.

Future research should seek to confirm these associations through multicenter and population-based studies, contributing to the development of reference values and cutoff points for motor competence classification in Brazilian children. Longitudinal studies are also recommended to examine the relationships among age progression, anthropometric changes, physical activity practice, and motor competence development.

References

1. ASHWELL, M.; GIBSON, S. A proposal for a primary screening tool: “Keep your waist circumference to less than half your height”. BMC Medicine, London, v. 12, p. 207, 2014.
2. BAO, R. et al. Associations between motor competence and executive functions in children and adolescents: a systematic review and meta-analysis. Sports Medicine, Auckland, v. 54, n. 3, p. 523–541, 2024.
3. CATTUZZO, M. T. et al. Motor competence and health-related physical fitness in youth: a systematic review. Journal of Science and Medicine in Sport, Sydney, v. 17, n. 2, p. 123–129, 2014.
4. DEN UIL, A. R. et al. The relationships between children’s motor competence, physical activity, and fitness: a longitudinal study. PLoS ONE, San Francisco, v. 18, n. 1, e0278438, 2023.

REMUNOM
ISSN 2178-6925

Received: 13/01/2026 - **Accepted:** 14/02/2026
Vol: 02.02
DOI: 10.66104/0h68ct15
Pages: 1-25

5. GALLAHUE, D. L.; OZMUN, J. C.; GOODWAY, J. D. Understanding motor development: infants, children, adolescents, adults. 7. ed. New York: McGraw-Hill, 2013.
6. MOON, J; WEBSTER, C. A.; STODDEN, D. F.; BRIAN, A; MULVEY, K. L.; BEETS, M et al. Systematic review and meta-analysis of physical activity interventions to increase elementary children's motor competence: a comprehensive school physical activity program perspective. BMC Public Health, London, v. 24, n. 1, p. 826, 15 Mar. 2024. DOI: 10.1186/s12889-024-18145-1.
7. MARMELEIRA, J.; VEIGA, G.; CANSADO, H.; RAIMUNDO, A. Relationship between motor proficiency and body composition in 6- to 10-year-old children. Journal of Paediatrics and Child Health, Melbourne, v. 53, n. 4, p. 348–353, Apr. 2017. DOI: 10.1111/jpc.13446.
8. MOREIRA, J. P. A. Desenvolvimento motor na infância. São Paulo: Manole, 2016.
9. MOSTAERT, M. et al. Age and gender differences in motor coordination. Research in Developmental Disabilities, Amsterdam, v. 48, p. 168–176, 2016.
10. PETROSKI, L. H.; TAGLIARI, I. A..The environment and measurement instruments for assessing the motor development of children and adolescents: a review study. Revista Multidisciplinar do Nordeste Mineiro, v. 2, n. 1, p. [páginas não divulgadas], 2026. DOI: 10.61164/cbk44936.
11. PIOTROWSKI, T. et al. Fundamental movement skills and physical activity in children: global trends and implications. Children, Basel, v. 9, n. 11, p. 1683, 2022.
12. PLATVOET, S. et al. Development of motor competence in children. Journal of Sports Sciences, London, v. 34, n. 8, p. 733-739, 2016.
13. REBELO, M. et al. Study of body composition and motor competence in children from the 1st basic cycle and their relationship with school performance. BMC Pediatrics, v. 25, p. 429, 2025.
14. ŠEFLOVÁ, I; CHUDOBA, J; DUNCAN, M; SUCHOMEL, A; BUNC, V. Motor

REMUNOM
ISSN 2178-6925

Received: 13/01/2026 - **Accepted:** 14/02/2026
Vol: 02.02
DOI: 10.66104/0h68ct15
Pages: 1-25

Competence Prevalence in School-Aged Czech Children: A Cross-Sectional Study. Journal of Motor Learning and Development, Champaign, v. 13, n. 1, p. 257-269, 1 Apr. 2025. DOI: 10.1123/jmld.2024-0010.

15. SILVA, A. F. Evaluating motor competence in children and youth: a narrative review. Human Movement, v. 26, 2025.
16. SOUZA, C. B. de; ARAÚJO, M. S.; PAIXÃO, J. J. A.; REIS, M. S dos; SOUZA, F. R de. Estratégias pedagógicas para o desenvolvimento motor nas aulas de Educação Física nos anos iniciais. Revista Multidisciplinar do Nordeste Mineiro, Uberlândia, v. 1, n. 1, 25 jul. 2023
17. SPRING, K. E. et al. Relationship between body composition and motor competence in early childhood. BMC Pediatrics, London, v. 23, p. 512, 2023.
18. STODDEN, D. F. et al. A developmental perspective on the role of motor skill competence in physical activity. Quest, v. 60, n. 2, p. 290-306, 2008.
19. THOMAS, Jerry R.; NELSON, Jack K.; SILVERMAN, Stephen J. Research Methods in Physical Activity. 6. ed. Champaign, IL: Human Kinetics, 2011.
20. ULRICH, D. A. Test of Gross Motor Development. 2. ed. Austin: Pro-Ed, 2000.
21. WEBSTER, E. K.; SUR, I.; STEVENS, A.; ROBINSON, L. E. Associations between body composition and fundamental motor skill competency in children. BMC Pediatrics, v. 21, p. 444, 2021.