The association between motor abilities and movement skills with cognitive abilities in preschool children

La asociación entre las habilidades motoras y las habilidades de movimiento con las capacidades cognitivas en niños en edad preescolar

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Abstract

Introduction: There is a lack of studies specifically analyzing the association between motor abilities and movement skills with cognitive abilities in children.
Objective: The study aimed to examine the association between motor abilities and movement skills with the cognitive abilities of preschool children.
Methodology: In this cross-sectional study, the total sample consisted of 91 children (41 boys and 50 girls), preschoolers aged five to six years (average age 6.09±0.38 years). Motor abilities were assessed through four Bruininks–Oseretsky (BOT-2) subtests, and movement skills were evaluated via the Test of Gross Motor Development (TGMD-2), while cognitive abilities were measured using the School Maturity Test (TZŠ+).
Results: Based on multiple regression analysis, significant associations between motor abilities and cognitive performance of preschool children were revealed. Specifically, the results demonstrated that motor abilities, particularly body coordination and fine motor integration explain a notable proportion of the variance in cognitive total scores. Contrary to expectations, movement skills did not demonstrate an association with cognitive abilities in preschool children.
Conclusions: In conclusion, the findings underline the importance of fostering comprehensive approaches to early childhood education that recognize the integral role of motor abilities in cognitive development. Further exploration is warranted to elucidate the specific mechanisms underlying the association between movement skills and cognitive development.

Keywords

Cognitive function; fundamental motor skills; gross motor skills; motor development; preschoolers.

Resumen

Introducción: Faltan estudios que hayan analizado específicamente la asociación entre las habilidades motoras y de movimiento con las habilidades cognitivas en niños.
Objetivo: El estudio tuvo como objetivo examinar la asociación entre las habilidades motoras y de movimiento con las habilidades cognitivas de niños en edad preescolar.
Metodología: En este estudio transversal, la muestra total consistió en 91 niños (41 niños y 50 niñas), preescolares de cinco a seis años (edad promedio de 6.09±0.38 años). Las habilidades motoras se evaluaron a través de cuatro subpruebas del Bruininks-Oseretsky Test of Motor Proficiency (BOT-2), y las habilidades de movimiento se evaluaron mediante el Test of Gross Motor Development (TGMD-2), mientras que las capacidades cognitivas se midieron utilizando el Test de Madurez Escolar (TZŠ+).
Resultados: Basado en el análisis de regresión múltiple, se reveló una asociación significativa entre las habilidades motoras y el rendimiento cognitivo de los niños en edad preescolar. Específicamente, los resultados demostraron que las habilidades motoras, particularmente la coordinación corporal y la integración de habilidades motoras finas, explican una proporción notable de la varianza en las puntuaciones cognitivas totales. Contrario a lo esperado, las habilidades de movimiento no demostraron una asociación con las capacidades cognitivas en los niños preescolares.
Conclusiones: En conclusión, los hallazgos subrayan la importancia de fomentar enfoques integrales en la educación infantil temprana que reconozcan el papel integral de las habilidades motoras en el desarrollo cognitivo. Se justifica una mayor exploración para dilucidar los mecanismos específicos subyacentes a la asociación entre las habilidades de movimiento y el desarrollo cognitivo.

Palabras clave

Desarrollo motor; función cognitiva; habilidades motoras fundamentales; habilidades motoras gruesas; niños preescolares.

Introduction

Important components of a child's maturation include harmonious motor and cognitive development (Payne & Larry, 2012). Motor development is observed through the development of motor abilities and movement skills (Aleksić Veljković et al., 2021; Lopes et al., 2021). Motor abilities represent latent abilities that participate in solving motor tasks and determine successful movement (Malacko & Popović, 2001, p. 57). Movement skills are acquired through practice and refer to the way of performing locomotor and object control tasks (Magill & Anderson, 2010, p. 9). To clarify, the difference is that abilities are partly innate and can be developed, while skills are acquired motor behaviors that depend on practice and experience in their execution. On the other hand, cognitive abilities refer to the human capacity for efficiently receiving, recognizing, storing, and processing information (Bayne et al., 2019, p. 608; Jakšić, 2016, p. 13). A similar definition of cognition, which refers to extracting, processing, and storing information, can also be found in other authors (Bayne et al., 2019, p.603).

Early childhood is considered one of the most important phases in overall development (Bala, 2002), and this critical period is characterized by swift development in multiple areas, including motor and cognitive skills (Jakšić, 2016, p. 39). Throughout the preschool years, children experience significant milestones in both their motor and cognitive capacities, laying the foundation for future learning and development (Bardid et al., 2016; Gallahue, 1983; Viegas et al., 2023). Consequently, there is an increasing focus on exploring the association between motor and cognitive abilities in children (Banjevic et al., 2022; Hernandez & Caçola, 2015; Kaloka et al., 2024; Martínez et al., 2023; Van der Fels et al., 2015).

The interplay between motor abilities and cognitive skills has increased attention from researchers and educators alike, as evidence suggests a bidirectional relationship between these domains (Hernandez & Caçola, 2015; Rivas Cun & Pereira, 2024). According to the theory of integral development (Bala, 2002, p. 6, as cited in Ismail & Gruber, 1971), progress in motor development can indirectly have a positive impact on cognitive development. While it is well-established that motor experiences play a fundamental role in cognitive functioning (Hillman et al., 2009; Hopkins et al., 2012; Sibley & Etnier, 2003), the specific mechanisms underlying this relationship in preschool-aged children remain an area of active inquiry (Stiles & Jernigan, 2010). Through both direct and indirect evidence, researchers have identified mediating mechanisms and mediational chains primarily associated with the alterations in brain function induced by the metabolic requirements of physical activity (PA) (Pesce et al., 2019). Understanding the association between motor abilities and movement skills with cognitive functioning during this formative period is essential for informing early childhood education practices and intervention strategies (Janssen, 2012). The motor skills of children were found to correlate with their performance on cognitive tasks related to attention and executive functions (Hernandez & Caçola, 2015; Maurer & Roebers, 2019).

Previous research investigating the relationship between motor and cognitive abilities in children has generally shown that there is a connection between these domains (Albuquerque et al., 2022; Geertsen et al., 2016; Hernandez & Caçola, 2015; Maurer & Roebers, 2019). Geertsen et al. (2016) showed that motor skills (coordination and fine motor skills) are positively related to several aspects of cognitive functions in 9-year-old children. Hernandez and Caçola (2015), in a sample of 4-year-old children, also found that motor skills are related to cognition. Albuquerque et al. (2022) examined the relationship between motor skills and executive functions in younger (6–8 years) and older (9–11 years) children. They found stronger correlations between motor and cognitive skills were achieved in the younger group compared to the older group. Meanwhile, Maurer and Roebers (2019) examined the relationship between the level of motor tasks and cognition, showing a stronger connection between more difficult motor tasks compared to easier ones. Although the relationship between motor and cognitive abilities has been shown in various studies, this connection has generally been moderate to weak. Additionally, it is noteworthy that motor abilities have primarily been measured through fine motor skills and coordination (Geertsen et al., 2016; Hernandez & Caçola, 2015; Maurer & Roebers, 2019), and only Albuquerque et al. (2022) investigated coordination and motor skills, but in their further analysis, motor abilities and skills were used as a general motor variable, so it is unclear which component and to what extent influenced cognitive abilities. It should also be noted that these results must be taken with caution due to the small sample size (Hernandez & Caçola, 2015). Furthermore, motor abilities have typically been assessed through a small number of motor tasks (Geertsen et al., 2016; Maurer & Roebers, 2019).

Based on the analysis of existing research, it is evident that there is a lack of studies that have specifically analyzed the association between motor abilities and movement skills with cognitive abilities in children. Therefore, there is a need for research that will explore this area in greater detail. To the authors' knowledge, this is the first study that thoroughly examines the relationship between both motor domains, motor abilities, and movement skills with cognitive abilities in preschool-aged children. Moreover, this is the only study with a sample that investigated the connection between these domains in children in Serbia. Therefore, this study aims to investigate how motor abilities and movement skills contribute to cognitive abilities in preschool children, with the goal of elucidating the complex dynamics between these interconnected domains. This research can contribute to a deeper understanding of the relationship between motor and cognitive domains in preschool-aged children and identify which motor parameters and to what extent are related to specific cognitive parameters.

Method

Participants

In this cross-sectional study, the total sample consisted of 91 preschoolers (41 boys, and 50 girls), aged five to six years (Table 1). Participants were chosen according to the following criteria: healthy children between the ages of five and six years of both genders, not engaged in organized physical exercise. Participation was voluntary, with parental consent obtained following the guidelines of the Helsinki Declaration. The Ethics Committee of the Faculty of Sport and Physical Education in Niš granted approval for the study (Ref. No. 04-1186/2).

Table 1. Sample description of preschool children

Variable	Mean	SD
Age	6.09	0.38
Body height (cm)	118.47	5.90
Body weight (kg)	22.93	4.35
Body mass index	16.25	2.13

Legend: Mean - Arithmetic mean; SD - Standard deviation.

Procedure

This cross-sectional study was conducted in November 2021. All testing of the children was conducted in their kindergarten during the morning hours (from 11 a.m.). Efforts were made to ensure that the children were well-rested for the testing so they could successfully perform the required tasks and to avoid daily variations. Everything was planned and conducted in this way to minimally disrupt their daily routine. The motor tests were administered by two experienced examiner in the kindergarten gym, while the cognitive tests were administered by a psychologist employed at the institution, testing the children in a special room. Additionally, the teachers working with the children assisted during all measurements. Their assistance involved organizing their groups and helping the children maintain focus, as well as ensuring they understood all tasks.

Instrument

Anthropometric Characteristics

Anthropometric measurements were conducted using standardized instruments. Martin's anthropometer measured body height, while the Tanita body fat scale (Tanita model BC-418MA, Tokyo, Japan) assessed body mass. Measurements followed established international biological procedures (Eston & Reilly, 2009). Body mass index (BMI) was used to assess the weight status of the subjects and was calculated using a standard formula based on body height (BH) and body mass (BM), which is as follows: $BMI=BM\ (kg)/BH\ (m)^2$.

Motor Abilities Assessment

Motor abilities were evaluated using subtests from the BOT-2 (Bruininks–Oseretsky Test of Motor Proficiency) battery. Evidence of various types of validity for the BOT-2 has been reported (Bruininks & Bruininks, 2005; Deitz et al., 2007; Wuang & Su, 2009; Wuang et al., 2012). Four subtests were utilized

for this study: fine motor integration, manual dexterity, motor balance, and bilateral coordination. These abilities were assessed using 29 motor tasks. The duration of the test was 20-30 minutes per participant. The composite of fine motor skills was derived from the fine motor integration and manual dexterity subtests, while the composite of body coordination was derived from the motor balance and bilateral coordination subtests.

Movement Skills Assessment

The Test of Gross Motor Development (TGMD-2) was used to evaluate fundamental movement skills. This assessment utilizes an observational technique to evaluate children's movement skills and has been validated for preschool-aged children (Ulrich & Sanford, 2000). The TGMD-2 consists of 12 movement tasks categorized into two subtests (locomotor and object control skills), which collectively yield a comprehensive gross motor composite score. The duration of TGMD-2 test was 15-20 minutes per child.

Cognitive Abilities Assessment

The cognitive abilities of children were assessed using three subtests from the Maturity Test for School (TZŠ+): visual memory, cube stacking, and coding. The study findings indicated strong validity and reliability of the TZŠ+, with significant correlations observed between TZŠ+ scores and cognitive tests such as TIP-1 and Raven's Color Matrix (Novović et al., 2009). Visual memory (Cognitive task 1) evaluates memory and attention; Stacking cubes (Cognitive task 2) assesses visual-motor coordination, perceptual organization, and planning; Coding (Cognitive task 3) gauges learning from experience, concentration, and visual-motor coordination. Combined, these subtests yield the overall cognitive abilities composite score (Cognitive total) (Novović et al., 2009). The duration of the cognitive tests was 15-20 minutes per child.

Data preparation

Each subtest's total score was recorded and then converted using standardized tables provided by the authors of the BOT-2, TGMD-2, and TZŠ+ tests, considering participants' gender and age (Bruininks & Bruininks, 2005; Novovic et al., 2007; Ulrich & Sanford, 2000). The standardized scores were then entered for further analysis, resulting in six variables for motor abilities, three for movement skills, and four for cognitive abilities.

Variables

For the purposes of this research, a total of 13 variables were analyzed, of which 9 represented motor abilities: Fine Motor Integration (FMI), Manual Dexterity (MD), Fine Motor Skills (FMS), Bilateral Coordination (BilC), Balance (Bal), Body Coordination (BC), and movement skills: Locomotor Skills (LS), Object Control (OC), and Gross Motor Skills (GMS). The remaining 4 variables represented the cognitive abilities of children: Visual Memory (VM), Stacking Cubes (SC), Coding (CO), and Cognitive Abilities Total (CAT).

Data analysis

For all test-derived data, basic central and distributional parameters were calculated. Skewness and kurtosis values were calculated to evaluate the normality of the data distribution. Multivariate associations among the predictors and criteria were evaluated using multiple regression analysis. Following the formula n=20+5k (where k denotes the number of predictors), as proposed by Khamis and Kepler (2010), the study determined the optimal number of predictor variables. Multiple regression analysis provided the coefficients R, R2, and p. Standardized coefficients (Beta) were also calculated to assess each variable's contribution to the final equation (see Table 2). Also, Pearson's correlation coefficient was used to determine the relationship between the variables. The strength of the correlation was determined according to Cohen (1988), where a weak correlation was defined as r=0.1–0.29, a moderate correlation as r=0.3–0.49, and a strong correlation as r=0.5–1.0. Statistical significance was determined at $p<0.05$. The data were analyzed using IBM SPSS Statistics, version 26 (SPSS Inc., Chicago, IL, USA).

Results

Table 2 presents descriptive data of children on tests of motor abilities, movement skills, and cognitive abilities. The results of the skewness coefficient (Skewness) range from -1 to 1, and the results of the

kurtosis coefficient (Kurtosis), which range from -2.75 to 2.75, are within the normal range of distribution values.

Table 2. Motor, movement and cognitive parameters of preschool children (n=91)

Variable	Mean	SD	Min	Max	Range	Skew	Kurt
Fine motor integration	13.44	4.07	4.00	24.00	20.00	0.13	-0.12
Manual dexterity	12.05	4.18	4.00	23.00	19.00	0.30	-0.40
Fine motor skills	25.49	6.41	12.00	40.00	28.00	0.23	-0.43
Bilaterall coordination	15.04	2.80	9.00	21.00	12.00	-0.16	-0.34
Balance	13.89	4.22	6.00	25.00	19.00	0.38	-0.50
Body coordination	28.93	5.82	17.00	41.00	24.00	-0.11	-0.76
Locomotor skills	6.80	1.62	3.00	11.00	8.00	-0.15	-0.01
Object controll	7.24	1.70	4.00	11.00	7.00	0.11	-0.41
Gross motor skills	14.04	2.95	7.00	22.00	15.00	0.05	-0.09
Visual memory	3.18	0.55	2.00	5.00	3.00	0.90	2.05
Stacking cubes	4.22	0.84	2.00	5.00	3.00	-0.55	-1.04
Coding	3.23	0.82	1.00	5.00	4.00	0.55	1.29
Cognitive abilities total	3.54	0.53	2.67	5.00	2.33	0.49	-0.15

Legend: Mean - Arithmetic mean; SD - Standard deviation; Min - Minimal value; Max – Maximal value; Skew – Skewness; Kurt – Kurtosis.

Table 3 presents the correlations between variables of motor abilities, movement skills, and cognitive abilities. A strong correlation was observed between the parameters of motor abilities FMS and MD (r=.783), as well as between FMS and FMI (r=.770). Additionally, strong correlations were noted between motor abilities BC and Bal (r=.893), and BC and BilC (r=.733), while a moderate correlation was found between Bal and BilC (r=.348), Bal and MD (r=.325), and a weak correlation was found between Bal and FMS (r=.211), and between BC and MD (r=.265).

Furthermore, significant weak relationships were recorded between LS and MD (r=.274), FMS (r=.243), Bal (r=.245), and BC (r=.247). OC showed a strong correlation with LS (r=.573), and moderate correlation with Bal (r=.225). GMS showed a strong correlation with other movement skills such as LS (r=.881), and OC (r=.893), and a weak correlation with motor abilities MD (r=.256), Bal (r=.265), and BC (r=.252).

VM exhibited a weak correlation only with MD (r=.218). SC showed a moderate correlation with FMI (r=.403) and FMS (r=.345), as well as a weak correlation with Bal (r=.267), BC (r=.223), and VM (r=.228). CO demonstrated a moderate correlation with SC (r=.346) and a weak correlation with Bal (r=.252) and VM (r=.230). When observing overall cognitive abilities (CAT), it exhibited strong correlations with other cognitive tasks such as SC (r=.780), CO (r=.770), and VM (r=.579). Meanwhile, it showed weak correlations with motor abilities such as FMS (r=.295), FMI (r=.268), Bal (r=.270), and BC (r=.231).

Results from the multiple regression analysis indicate that a model incorporating four independent motor ability variables (fine motor integration, manual dexterity, bilateral coordination, and body coordination) accounts for 14.8% (R^2=.148) of the variance in the overall cognitive score (see Table 4), with statistical significance (p=.008). According to the beta coefficients, the variables with a significant contribution to this model are body coordination (0.349) and fine motor integration (0.257). When considering the impact of motor abilities on different cognitive tasks, a significant effect was achieved only on the second cognitive task (Stacking cubes), where motor abilities explain 23.6% (R^2=.236) of the variance in the given dependent variable at a significant level (p=0.000). Based on the beta coefficients, the variables with a significant contribution to this model are fine motor integration (0.411) and body coordination (0.391). There were no significant models for the remaining cognitive tasks.

Regarding movement skills, the model was not significant for any of the dependent cognitive variables, meaning that motor skills did not have a significant impact on cognitive abilities.

Table 3. Correlation matrix between parameters of motor abilities, movement skills, and cognitive abilities

Variable		FMI	MD	FMS	BilC	Bal	BC	LS	OC	GMS	VM	SC	CO
MD	r	0.206											
	p	0.051											
FMS	r	.770**	.783**										
	p	0	0										
BilC	r	-0.062	0.062	0.001									
	p	0.558	0.562	0.995									
Bal	r	-0.002	.325**	.211*	.348**								
	P	0.987	0.002	0.045	0.001								
BC	r	-0.031	.265*	0.153	.733**	.893**							

LS	p	0.77	0.011	0.147	0	0							
	r	0.101	.274**	.243*	0.144	.245*	.247*						
OC	p	0.341	0.009	0.02	0.173	0.019	0.018						
	r	-0.068	0.183	0.076	0.077	.225*	0.2	.573**					
GMS	p	0.519	0.083	0.477	0.467	0.032	0.057	0					
	r	0.016	.256*	0.177	0.124	.265*	.252*	.881**	.893**				
VM	p	0.881	0.014	0.093	0.242	0.011	0.016	0	0				
	r	0.054	.218*	0.177	0.089	0.004	0.045	-0.048	0.002	-0.025			
SC	p	0.608	0.038	0.093	0.402	0.973	0.669	0.653	0.988	0.811			
	r	.403**	0.136	.345**	0.062	.267*	.223*	0.073	-0.038	0.018	.228*		
CO	p	0	0.2	0.001	0.559	0.011	0.033	0.491	0.724	0.862	0.03		
	r	0.073	0.087	0.103	0.02	.252*	0.192	0.119	0.143	0.148	.230*	.346**	
CAT	p	0.494	0.41	0.331	0.852	0.016	0.068	0.263	0.176	0.162	0.028	0.001	
	r	.268*	0.191	.295**	0.073	.270**	.231*	0.082	0.054	0.077	.579**	.780**	.770**
	p	0.01	0.07	0.005	0.494	0.01	0.028	0.438	0.61	0.471	0	0	0

Legend: FMI - Fine motor integration; MD - Manual dexterity; FMS - Fine motor skills; BilC - Bilateral coordination; Bal – Balance; BC - Body coordination; LS - Locomotor skills; OC - Object controll; GMS - Gross motor skills; VM - Visual memory; SC - Stacking cubes; CO – Coding; CAT - Cognitive abilities total; r - Pearson's correlation coefficient; p – signifacane; *-The correlation is significant at the 0.05 level, **-The correlation is significant at the 0.01 level.

Table 4. The association between motor abilities and movement skills with cognitive abilities

Variable	Visual memory	Stacking cubes	Coding	Cognitive total
Fine motor integration	.011	.411*	.072	.257*
Manual dexterity	.247	-.040	-.015	.056
Bilateral coordination	.192	-.197	-.260	-.171
Body coordination	-.161	.391*	.389	.349*
R	.254	.485	.272	.384
R^2	.064	.236	.074	.148
p	.216	.000*	.155	.008*
Locomotor skills	-.114	.254	-.052	.066
Gross motor skills	.075	-.205	.194	.018
R	.060	.121	.150	.083
R^2	.004	.015	.022	.007
p	.856	.520	.368	.739

Legend: aexcluded variables from a models: fine motor skills, balance, and object controll; R – multiple correlation; R2 – coefficient of determination; p – level of significance.

Discussion

The results of this research add to the expanding literature investigating the complex interplay among motor abilities, and movement skills, with the cognitive abilities in young children. The investigation revealed significant associations between motor abilities and cognitive performance in preschool-aged children. Specifically, the results demonstrated that motor abilities, particularly body coordination, and fine motor integration, significantly predicted cognitive functioning, explaining a notable proportion of the variance in cognitive total scores. These findings align with previous research highlighting the interconnectedness of motor and cognitive domains during early childhood (Albuquerque et al., 2022; Geertsen et al., 2016; Hernandez & Caçola, 2015; Maurer & Roebers, 2019). The observed association between motor abilities and cognitive tasks highlights the importance of considering holistic approaches to early childhood development, where motor skill development is integrated into educational frameworks aimed at fostering cognitive growth (Kurnia et al., 2024).

Notably, the study identified a significant association between motor abilities and specific cognitive tasks, particularly visual-motor coordination and perceptual organization. Fine motor integration and body coordination emerged as key predictors of performance on these tasks, suggesting that the refinement of motor abilities may facilitate cognitive processes involved in visual-motor coordination and perceptual organization. These findings are consistent with the confirmed association between fine motor skills and cognitive abilities in previous studies (Geertsen et al., 2016; Hernandez & Caçola, 2015; Maurer & Roebers, 2019). Also, some studies indicate a connection between fine motor skills and early reading development, as well as future success in mathematics and science among preschoolers (Brookman et al., 2013; Cameron et al., 2012). It is also known that the development of fine motor skills influences sensorimotor development of the nervous system (Case-Smith, 1995), and consequently, speech development (Ivković et al., 2004), which is particularly important at an age when children may have difficulty articulating all sounds.

Additionally, the established association between coordination and cognitive abilities in our study aligns with recent studies (Planinsec, 2002; Taras, 2005; Vojtíková et al., 2023) that have found a positive association between coordination and cognitive abilities directly impacting learning and academic success. The reason for this association lies in the fact that coordination represents one of the most complex motor abilities that harmonizes other motor abilities during movement execution (Cordo & Gurfinkel, 2004; Rađo & Malacko, 2004). This corresponds to the findings of Maurer and Roebers (2019), who identified a stronger relationship between cognitive abilities and more challenging motor tasks such as coordination tasks, compared to easier ones.

The association between motor and cognitive abilities may stem from their parallel developmental trajectories, characterized by rapid advancement during the preschool years (Anderson et al., 2001; Martin et al., 2010). Furthermore, both motor and cognitive skills involve common fundamental processes like sequencing, tracking, and planning (Roebers & Kauer, 2009). This connection is reinforced by a neuropsychological viewpoint, suggesting that the interplay between motor and cognitive skills is facilitated by the simultaneous activation of the cerebellum, essential for complex and coordinated movements, and the frontal cortex, crucial for higher-order cognitive functions (Diamond, 2000).

Contrary to expectations, movement skills, as assessed by the Test of Gross Motor Development, did not demonstrate a significant association with cognitive abilities in preschool children. This unexpected finding suggests that while fundamental movement skills are essential for physical competence, they may not exert an association with cognitive performance. Although the review study by Shi and Feng (2022) showed that performing motor skills has benefits for various cognitive abilities, the direct link between these domains has been absent in our context. Further exploration is warranted to elucidate the specific mechanisms underlying the association between movement skills and cognitive development, considering potential moderating variables such as environmental factors and instructional practices.

The present study contributes to a deeper understanding of the complex interplay between motor abilities, movement skills, and cognitive functioning in preschool-aged children. By highlighting the differential impact of motor and movement skills on cognitive outcomes, educators and practitioners can tailor interventions to address specific areas of need and promote holistic development in young learners. Future research endeavors should explore longitudinal associations between motor and cognitive development, examine the effectiveness of targeted interventions, and investigate contextual factors that may influence the association between motor abilities and cognitive functioning.

Conclusions

Research has shown that there is a significant relationship between motor abilities and cognitive skills in preschool children. Specifically, a association was established between body coordination and fine motor skills with overall cognitive abilities, as well as with the cognitive task of Stacking cubes, which relates to visual-motor coordination, perceptual organization, and planning. However, when it comes to fundamental movement skills, they did not show a significant relationship with cognitive abilities, indicating the need for further research in this area.

This study fulfilled its goal of examining the association between motor domains and cognitive abilities. The findings suggest that a relationship was established between motor abilities and cognition, while the relationship between motor skills and cognitive abilities was absent. These findings will contribute to a deeper understanding of the relationship between the motor and cognitive domains in preschool children, as they identified which motor parameters and to what extent are associated with specific cognitive parameters.

Such findings can help educators and practitioners working with children to better understand the complex interactions between motor and cognitive development and to adapt certain motor tasks in their work with children.

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