

Original Article

Analysis the Influence of Geographical, Socioeconomic, Digital Technology, and Cultural in the Development of Preschool Children's Motor Skills

Sulfi Mayang Sari¹, Aulia Putri Yuliasti², Ahmat Fauzi^{3*}

^{1,2,3}Department of Physical Education, Faculty of Teacher Training and Education, University of Islam Kalimantan Muhammad Arsyad Al Banjari, Banjarmasin, Indonesia

*Correspondence: ahmatfauzi@uniska-bjm.ac.id

Abstract

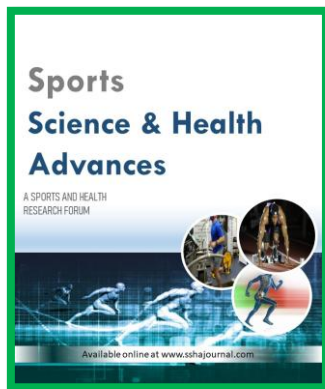
Background: children's motor development can be influenced by factors including geographic location, socioeconomic status, access to technology, and local cultural conditions. Understanding these relationships is critical to designing effective interventions and strategies to optimize child development. **Purpose:** The aim of this research is to analyze the influence of geographic location, socio-economic status, use of technology on the basic motor skills of children aged 3-5 years. **Material and Methods:** A group of 94 children in South Kalimantan province aged between 3 and 5 years. Data collection was carried out in 8 different schools, and motor skills were assessed using the MOBAC-KG test to assess basic motor competence (BMC) in kindergarten and one-factor analysis of variance (ANOVA) was used to determine whether the motor skills of preschool children differ based on their geographic location, socio-economic status, access to technology, and local cultural conditions. **Results:** This research shows that various external factors, such as geographic location, socioeconomic status, access to digital technology, and cultural background, influence the development of children's motor skills. **Conclusion:** Boys, especially in urban areas with higher socioeconomic status, access to digital technology, and modern cultural background, show better performance. Girls showed fewer differences, although some girls from rural areas with lower socioeconomic status and conventional cultural backgrounds excelled in certain skills such as "Jumping" and "Throwing".

Keywords: Childhood, Motor Skills, MOBAC-KG

Introduction

The development of motor skills during childhood is very important for overall growth, influencing physical health, cognitive abilities, and social interactions (Shi & Feng, 2022) (Adolph & Hoch, 2020) (Zulrafla & Kamarudin, 2021). In particular, motor development in infancy is very important because it provides the basis for more advanced perceptual and cognitive skills (Aye et al., 2017). These basic motor skills are essential for personal development and the acquisition of more complex skills needed in everyday life (Xia et al., 2022) (Peyre et al., 2019).

Access to facilities, climate, and urban versus rural environments play a role in program implementation and outcomes. For example, a study by Bardid (Bardid et al., 2013) evaluated a 10-week basic motor skills program in pre-school children with motor problems and found that environmental context, including the community of residence, influenced the development of children's motor skills. Socioeconomic status (SES) is an important determinant in children's access to motor skill development opportunities (Kwon & O'neill, 2020). Children from lower SES backgrounds often have limited access to quality physical education and recreation facilities, which can hinder children's



Peer-Reviewed
Refereed
Indexed



How to cite: Sari, S. M., Yuliasti, A. P., & Fauzi, A. (2026). Analysis the influence of geographical, socioeconomic, digital technology, and cultural factors in the development of preschool children's motor skills. *Sports Science & Health Advances*. 4(1), 587-595.
<https://doi.org/10.60081/SSHA.4.1.2026.587-595>

Received: 24-04-2026
Accepted: 04-06-2026
Published: 30-06-2026



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motor development (Wong et al., 2022). Van der Walt (Van der Walt, J., Plastow, N.A. & Unger, 2020) conducted a scoping review highlighting that motor skill disorders are prevalent in pre-school children in low socioeconomic areas, emphasizing the need for tailored intervention strategies in this community.

Digital integration of technology has shown promising results in improving children's motor skills (Page et al., 2017) (Jenny et al., 2017). For instances, extended reality (XR) technologies, including virtual reality (VR) and augmented reality (AR) have significant potential to increase children's physical and motor activity levels (Power et al., 2024). Various technologies include tablets (40%), computers/computer games (17%), robots (9%), projection devices (6%), video models (6%), whiteboards (3%), and motion sensor 3D cameras scanner (ASUS Targeted academic outcomes in Head Start preschools were the most common across studies. Results range from no effect to very effective (Paul et al., 2023). However, gaps in access to technology can pose challenges. Children in less resourced areas may not benefit from technology-enhanced interventions due to lack of access. A narrative review by Lopes (Lopes et al., 2021) suggests that although technology can aid the development of motor competence, its effectiveness depends on accessibility and appropriate implementation.

Cultural context influences the types of physical activity that are encouraged and accepted in a community. Intervention programs that are culturally sensitive and incorporate local traditions tend to be more effective (Montayre et al., 2020) (Joo & Liu, 2021). A technical report by (Baghwanji, Yash; Santos, Rosa Milagros; Fowler, 2000) emphasized the importance of culturally and linguistically sensitive practices in motor skills interventions for children, advocating adaptation of programs to suit cultural contexts. However, the success of such interventions may be influenced by factors including geographic location, socioeconomic status, access to technology, and local cultural conditions (Morley et al., 2015) (Peralta et al., 2019) Neighborhood contexts, such as residential community and recreational spaces, have been researched for their impact on intervention outcomes, although some studies suggest that they may not significantly alter effectiveness (Faira Zanada et al., 2023) (Hunter et al., 2019).

Socioeconomic status and access to resources are critical in determining children's opportunities to engage in physical activity and participate in intervention programs (Logan et al., 2012). Limited access to technology and safe recreational spaces can hinder the implementation and success of motor skills interventions (Barrett et al., 2019) (Sutapa et al., 2021) (Staiano et al., 2022). Additionally, cultural factors play a role in shaping children's engagement in physical activity, as community norms and values influence the types of activities that are considered appropriate or desirable (Hassan et al., 2024).

Understanding these relationships and disparities is vital for designing effective interventions and strategies for optimistic child development. Therefore, the aim of this research is to analyze the influence of geographic location, socio-economic status, use of digital technology and culture on the development of basic motor skills in children aged 3-5 years.

Materials and Methods

Participants

The sample consisted of 94 preschool children in South Kalimantan, aged between 3 and 5 years. The selection of participants was carried out through non-probabilistic procedures, using samples based on geography, socio-economic status, use of digital technology. Participants were selected from eight educational kindergartens located in various cities in South Kalimantan. Of the eight kindergartens, five are in urban areas where the use of digital technology is adequate and three are in rural areas where the use of digital technology is still limited. Based on their place of origin, 26 preschool children came from rural areas where socio-economically, the use of digital technology was still limited, while 68 came from urban areas where socio-economically and the use of digital technology was adequate. After presentation of our explanation of the study and procedures, the children's guardians or parents signed written informed consent. To participate in this study, children must not suffer from diseases or difficulties that prevent participation in the development of MOBAK KG (Herrmann et al., 2020). All participants were evaluated in the Physical Education (PJ) gymnasium.

Procedures

The MOBAK KG test is conducted during regularly scheduled physical education sessions. This approach leverages the infrastructure available at participating schools, allowing each class to be tested during a predetermined schedule. This facilitates participation without disrupting the regular academic schedule. Assessments are carried out at various stations, which are strategically placed in designated physical education areas, either in the gymnasium or on the school playground, depending on the resources available at each school. Assessments are carried out in groups, with all students in a class participating simultaneously. During the session, students rotate through four stations to ensure that each student completes all planned tests. First, four posts for object movement skills, then four posts for self-movement skills. Before each test, a demonstration and explanation of the test was given to each preschool child, according to the MOBAK KG protocol (Herrmann et al., 2020). Participants performed tests belonging to the object movement subscale: throwing with one hand at a fixed target, catching a bouncing ball with two hands, catching with a two-handed clap, and dribbling the ball with the feet over an obstacle. After that, they performed tests integrated in the self-movement subscale: walking forward and backward on a balance beam, rolling forward on an inclined plane, jumping on one leg back and forth, and running back and forth. A score of 0 points is given for zero successful attempts, 1 point for one successful attempt, and 2 points for two successful attempts. General procedures for assessing BMC and criteria for success or failure are described elsewhere (Herrmann et al., 2020).

Statistical Analysis

One-factor analysis of variance (ANOVA) was used to determine whether preschool children's motor skills differed based on their geographic location, socioeconomic status, access to technology, and local cultural conditions. This statistical method allows comparison of mean scores between groups, providing a rigorous approach to identifying variations in motor skills caused by differences in geography, socioeconomic status, access to digital technology and culture. Data relating to geographic area categories as rural vs. urban, socioeconomic status categories as low vs. above, categories of access to digital technology as adequate vs. inadequate, and culture as conventional vs. modern were included as fixed factors, and motor skills were categorized as developmental insufficient (0), sufficient development (1), and good development (2) were entered as dependent variables. All analyzes were carried out on all children aged 3 – 5 years. The significance level was set at $p < 0.05$. Analysis was carried out using SPSS (version 22.0 for Windows 10 64bit).

Results

The study population consisted of preschool children from urban (n=68) and rural (n=26) environments, upper (n=68) and lower (n=26) socioeconomic status, inadequate access to digital technology (68) and adequate (n=26), conventional culture (n=26) and modern culture (n=68), aged between 3 and 5 years. Table 1 presents geographical details, socio-economic status, access to digital technology and cultural heritage of participants.

Table 1 Biometric background of participants categorized by male and female

Variables	ALL (N=94)		MALE (N=48)		FEMALE (N=46)		p
	N	%	N	%	N	%	
Geographical Environment							
Urban	68	72.3	34	70.8	34	73.9	0.739
Rural	26	27.7	14	29.2	12	26.1	
Socio-economic status							
Lower	26	26.7	14	28.1	12	25.2	0.741
Upper	68	62.3	34	70.5	34	74.1	
Cultural							
Conventional	26	27.5	14	29.1	12	25.9	0.729
Modern	68	73.2	34	71.7	34	72.9	
Access to technology							
Adequate	68	71.1	34	70.7	34	74.5	0.745
Inadequate	26	26.9	14	28.9	12	27.2	

Table 2 showed a t-value of 0.390, which was also below the critical t-value at the 0.05 significance level. Accordingly, the analysis indicated no significant relationship between physical fitness (X2) and physical activity (Y) among the same group of students. This result implied that higher physical fitness levels did not necessarily correspond to increased physical activity among third-grade students. Table 2 shows the results of variance analysis differentiated by male, female and geographical. The study found that children (males) in urban areas had better motor skills compared to their counterparts in rural areas. However, children (females) in urban areas show superior self-movement skills, but their object control skills are lower than their counterparts in rural areas. More specifically, regarding self-movement skills, children (males) from rural areas showed lower performance in "Jumping" ($p=0.021$) and "Rolling" ($p=0.007$) compared to their urban counterparts. However, children (female) from rural areas showed better performance in "Rolling" compared to girls from urban areas ($p=0.036$). In terms of object movement skills, preschool children living in rural areas showed lower skills in "Bouncing" compared to those living in urban areas, both for children (male) and children (female) ($p=0.003$ and $p=0.004$ respectively). Additionally, children (males) in rural areas had lower scores in "Catching" compared to their urban counterparts ($p=0.015$). In contrast, children (females) in rural areas scored higher in "Throwing" compared to students in urban areas ($p=0.029$). Additionally, there are several important findings when analyzing skill-based performance in various environments. In urban areas, children (males) showed the worst performance in the "Throwing" skill, while children (females) showed the worst performance in "Dribbling". On the other hand, the skills in which children (male) excel are "Running" and "Jumping", while children (female) only excel in "Jumping". In contrast, in rural areas, both children (male) and children (female) had the lowest scores in "Jumping". However, the skills with the highest scores differ between males and females, with "Running" being the highest for children (male) and "Rolling" for children (female).

Table 2. Comparison of motor skills based on geography

		MALE					FEMALE				
		Rural		Urban		<i>p</i>	Rural		Urban		<i>p</i>
		Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Self-Movement Skills	Running	1.59	0.516	1.81	0.412	0.121	1.60	0.671	1.67	0.599	0.761
	Jumping	1.38	0.844	1.81	0.412	0.021	1.44	0.902	1.76	0.513	0.142
	Rolling	0.95	0.919	1.67	0.693	0.007	1.69	0.653	1.11	0.832	0.036
	Balancing	1.45	0.854	1.78	0.556	0.113	1.52	0.800	1.64	0.699	0.633
	Catching	1.23	0.977	1.78	0.498	0.015	1.60	0.517	1.37	0.814	0.367
Control Object Skills	Throwing	1.44	0.854	1.34	0.686	0.657	1.52	0.676	0.90	0.846	0.029
	Bouncing	0.66	0.844	1.61	0.659	0.003	0.52	0.676	1.31	0.786	0.004
	Dribbling	1.09	0.831	1.40	0.699	0.192	0.94	0.675	0.84	0.675	0.721

SD = Standard Deviation

Table 3 describes the results of the analysis of variance based on gender (male and female) and socio-economic status. This study revealed that boys from high socioeconomic backgrounds demonstrated superior motor skills compared to those from low socioeconomic backgrounds. In contrast, girls from high socioeconomic status excelled in self-movement skills, although their object control skills were lower than girls from low socioeconomic status. Specifically, in self-movement skills, boys from low socioeconomic backgrounds showed weaker performance in "Jumping" ($p=0.009$) and "Rolling" ($p=0.005$) compared to boys from lower socioeconomic backgrounds. high socio-economic. However, girls from low socioeconomic backgrounds outperformed those from high socioeconomic backgrounds in "Rolling Over" ($p=0.024$). Regarding object movement skills, preschool children from low socioeconomic backgrounds showed weaker abilities in "Bouncing" compared with those from high socioeconomic backgrounds, affecting both boys and girls ($p=0.001$ and $p=0.001$, each). Additionally, boys from low socioeconomic backgrounds had lower scores in "Catching Up" compared to their peers from high socioeconomic backgrounds ($p=0.013$). In contrast, girls from low socioeconomic backgrounds scored higher in "Throwing" than girls from high socioeconomic backgrounds ($p=0.017$). The study also found that boys of high socioeconomic status had the most difficulty in "Throwing," while girls performed the worst in "Dribbling." On the other hand, boys excel in "Running" and "Jumping," while girls only excel in "Jumping." In contrast, children from low socioeconomic backgrounds, both boys and girls, had the lowest scores on

“Jumping.” However, top scores differ by gender, with boys excelling in “Running” and girls in “Rolling.”

Table 3 Comparison of motor skills based on socioeconomics

		Male					Female				
		Upper		Lower		p	Upper		Lower		p
		Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Self-Movement Skills	Running	1.47	0.504	1.69	0.400	0.109	1.48	0.659	1.55	0.587	0.749
	Jumping	1.26	0.832	1.69	0.400	0.009	1.32	0.890	1.64	0.501	0.130
	Rolling	0.83	0.907	1.55	0.681	0.005	1.57	0.641	0.99	0.820	0.024
	Balancing	1.33	0.842	1.66	0.544	0.101	1.40	0.789	1.55	0.687	0.621
Control Object Skills	Catching	1.11	0.965	1.66	0.486	0.003	1.48	0.505	1.25	0.801	0.355
	Throwing	1.33	0.842	1.22	0.674	0.645	1.40	0.664	0.78	0.834	0.017
	Bouncing	0.54	0.832	1.49	0.647	0.001	0.40	0.664	1.19	0.774	0.001
	Dribbling	0.97	0.819	1.28	0.670	0.180	0.82	0.663	0.72	0.663	0.709

SD = Standard Deviation

Table 4 shows the results of analysis of variance categorized by gender (male and female) and access to digital technology. This research reveals that boys with adequate digital technology show better motor skills compared to boys with inadequate digital technology. However, girls with adequate digital technology show superior self-motion abilities, although their object control skills are not as strong as girls with adequate digital technology. Specifically, boys with inadequate digital technology demonstrated lower performance in “Jumping” (p=0.029) and “Rolling” (p=0.015) compared to their peers on adequate digital technology. On the other hand, girls with inadequate digital technology showed better performance in "Rolling" compared to girls with adequate digital technology (p=0.044). Regarding object movement skills, preschool children with inadequate digital technology showed lower skills in "Bouncing" compared to children with adequate digital technology, for both boys and girls (p=0.011 and p=0.012, respectively). Additionally, boys with inadequate digital technology had lower scores in “Catching” compared to their peers with adequate digital technology (p=0.023). In contrast, girls with inadequate digital technology scored higher in "Throwing" compared to girls with adequate digital technology (p=0.037). Additionally, several key trends emerge when evaluating skill-based performance across various digital access technologies. With adequate digital technology, boys showed the worst performance in "Throwing", while girls had the lowest performance in "Dribbling". Boys excel in "Running" and "Jumping", while girls only excel in "Jumping". In contrast, with inadequate digital technology, both boys and girls had the lowest scores in "Jumping". However, the highest scoring skills differed between genders, with boys excelling in “Running” and girls excelling in “Rolling.”

Table 4 Comparison of motor skills based on digital technology access

		Male					Female				
		Adequate		Inadequate		p	Adequate		Inadequate		p
		Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Self-Movement Skills	Running	1.67	0.524	1.89	0.420	0.129	1.68	0.679	1.75	0.607	0.769
	Jumping	1.46	0.852	1.89	0.420	0.029	1.52	0.910	1.84	0.521	0.150
	Rolling	1.03	0.927	1.75	0.701	0.015	1.77	0.661	1.19	0.840	0.044
	Balancing	1.53	0.862	1.86	0.564	0.121	1.60	0.808	1.72	0.707	0.641
Control Object Skills	Catching	1.31	0.985	1.86	0.506	0.023	1.68	0.525	1.45	0.822	0.375
	Throwing	1.53	0.862	1.42	0.694	0.665	1.60	0.684	0.98	0.854	0.037
	Bouncing	0.74	0.852	1.69	0.667	0.011	0.60	0.684	1.39	0.794	0.012
	Dribbling	1.17	0.839	1.48	0.707	0.200	1.02	0.683	0.92	0.683	0.729

Table 5 shows the results of analysis of variance categorized by gender (male and female) and culture. This research revealed that boys with a modern cultural culture showed better motor skills compared to their counterparts with a conventional cultural culture. In contrast, girls from a modern cultural culture showed higher self-movement skills, although their object control skills were lower compared to girls from a conventional cultural culture. Specifically, boys with a conventional cultural culture performed weaker in “Jumping” (p=0.019) and “Rolling” (p=0.005) compared to boys with a modern cultural culture. On the other hand, girls with a conventional cultural culture outperformed girls with a modern cultural culture in "Rolling" (p=0.034). In terms of object

movement skills, preschool children with a conventional culture showed lower abilities in “Bouncing” compared to their peers with a modern culture, for both boys and girls ($p=0.001$ and $p=0.002$ respectively join in). In addition, boys from a conventional culture had lower scores in “Catching” compared to boys from a modern culture ($p=0.013$). In contrast, girls from conventional culture had higher scores in “Throwing” compared to girls from modern culture ($p=0.027$). Furthermore, the study uncovered several important trends when evaluating performance across environments. By modern culture, boys perform the worst in “Throwing,” while girls have the most difficulty in “Dribbling.” In contrast, boys excelled in “Running” and “Jumping,” while girls excelled only in “Jumping.” By conventional culture, both boys and girls have the lowest scores in “Jumping.” However, the highest-scoring skills differ, with boys excelling in “Running” and girls in “Rolling.”

Table 5 Comparison of motor skills based on culture

		Male					Female				
		Conventional		Modern		<i>p</i>	Conventional		Modern		<i>p</i>
		Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Self-Movement Skills	Running	1.57	0.514	1.79	0.410	0.119	1.58	0.669	1.65	0.597	0.759
	Jumping	1.36	0.842	1.79	0.410	0.019	1.42	0.900	1.74	0.511	0.140
	Rolling	0.93	0.917	1.65	0.691	0.005	1.67	0.651	1.09	0.830	0.034
	Balancing	1.43	0.852	1.76	0.554	0.111	1.50	0.798	1.62	0.697	0.631
Control Object Skills	Catching	1.21	0.975	1.76	0.496	0.013	1.58	0.515	1.35	0.812	0.365
	Throwing	1.43	0.852	1.32	0.684	0.655	1.50	0.674	0.88	0.844	0.027
	Bouncing	0.64	0.842	1.59	0.657	0.001	0.50	0.674	1.29	0.784	0.002
	Dribbling	1.07	0.829	1.38	0.697	0.190	0.92	0.673	0.82	0.673	0.719

Discussion

The findings presented in Tables 2 to 5 provide significant insight into the relationship between gender, geography, socioeconomic status, access to digital technology, and cultural background on the development of motor skills and self-movement skills in preschool-aged children. These results offer a valuable perspective for understanding how various external factors influence children's physical abilities, which are critical to their overall development.

Effect of Geography on Motor Skills Table 2 shows that urban and rural environments play an important role in shaping children's motor skills. In general, boys in urban areas show better motor skills compared to those in rural areas. This trend is especially visible in skills such as “Jump” and “Roll.” Possible explanations for these differences could be related to disparities in resources, access to extracurricular activities, and perhaps the availability of special programs that support physical development in urban areas. In contrast, girls from rural areas showed better performance in certain motor skills, such as “Rolling,” suggesting that environmental factors and perhaps the influence of local community practices may have a greater impact on skill development for girls. However, rural environments were associated with lower performance in object movement skills, such as “Bouncing” and “Catching.” These differences may reflect differences in access to recreational facilities or equipment in rural areas. Additionally, the finding that girls from rural areas outperformed their peers in urban areas in “Throwing” is interesting, which may indicate that rural environments place a higher emphasis on a different type of physical activity, perhaps more aligned with traditional games.

Socioeconomic Status and Skill Development Table 3 highlights the influence of socioeconomic status on children's motor skills. Boys from higher socioeconomic backgrounds outperformed children from lower socioeconomic backgrounds, especially in physical skills such as “Running” and “Jumping.” These findings are consistent with existing research showing that children from families with higher socioeconomic status often have better access to enriching environments, such as extracurricular programs and better health care, which can support physical development. For girls, the impact of

socioeconomic status on motor skills is more complicated. Although girls from higher socioeconomic backgrounds excel in self-movement skills, their object control skills are weaker compared to their peers from lower socioeconomic backgrounds. This paradox may stem from differences in social expectations and access to different types of physical activity for girls in different socioeconomic settings. It would be interesting to further explore how cultural attitudes toward gender and physical activity shape skill development across different socioeconomic groups.

Access to Digital Technology and Its Impact on Motor Skills The role of digital technology, as presented in Table 4, adds a layer of complexity in understanding motor skill development. Boys with adequate access to digital technology demonstrated superior motor skills compared to those with inadequate access, indicating that digital tools can complement physical activity by providing interactive learning opportunities that improve motor skills. However, for girls, although adequate access to digital technology supports better self-movement skills, their object control skills are not as strong as those of girls with limited access. These gender differences may reflect the way technology is used differently by boys and girls, with boys perhaps engaging more in video games that encourage physical movement or digital platforms that encourage physical activity. Additionally, the finding that children with inadequate access to digital technology performed worse in “Bouncing” and “Catching” skills in both genders suggests that limited exposure to digital tools may limit opportunities for children to practice or improve their coordination and fine motor skills. The positive relationship between adequate digital access and motor skill performance highlights the need for equal access to technology to support children's development.

Cultural Background and Its Influence on Skill Performance Finally, Table 5 provides valuable insight into the impact of cultural background on motor skill development. Boys with modern cultural backgrounds outperform those with conventional cultural backgrounds, especially in motor skills such as “Running” and “Jumping.” This may reflect a more dynamic and active lifestyle often associated with modern cultural environments, which may place greater priority on physical activity. On the other hand, girls from conventional cultural backgrounds showed better performance in “Rolling,” indicating that traditional cultural practices may place a different emphasis on physical activity. Differences in “Throwing” and “Dribbling” between boys and girls across various cultural backgrounds highlight gender-bound patterns of physical activity, with boys in modern cultural settings struggling with “Throwing” and girls facing challenges with “Dribbling.” These results suggest that cultural norms and expectations regarding gender roles may influence the types of activities that boys and girls are encouraged to participate in, which in turn influences the development of their motor skills.

Conclusion

This research has comprehensively examined the development of motor skills in boys and girls aged 3-5 years, taking into account geographical location, socio-economic status, use of digital technology and cultural factors. Data shows it has a significant impact on the motor development of preschool children, especially in boys. Boys with urban geography, high socioeconomic status, who have access to adequate use of digital technology and modern cultural culture show superior performance in self-movement skills and object control. However, girls in general do not show significant differences based on geographic location, socio-economic status, use of digital technology and culture. Only in certain skills such as “Jumping” and “Throwing”, girls with rural geography, low socio-economic status, minimal access to digital technology and conventional culture get better scores. This shows that geographical location, socio-economic status, use of digital technology and culture have a more significant influence on children's motor development.

Acknowledgment

The authors express their gratitude to all participants who contributed to the study.

Conflicts of interest

The authors declare no conflicts of interest.

ORCID

Sulfi Mayang Sari  Not Available

Aulia Putri Yulianti  <https://orcid.org/0009-0003-3105-8678>

Ahmat Fauzi  <https://orcid.org/0009-0007-4865-3472>

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