



Analysis of motor competence in elementary school students aged 7 to 12 years: comparison between students in the highlands and lowlands in Indonesia

Análisis de la competencia motora en estudiantes de primaria de 7 a 12 años: comparación entre estudiantes de las tierras altas y bajas de Indonesia

Authors

Ibnu Andli Marta¹
Tisna Syafnita¹
Ari Suriani¹
Itgo Hachi²
Venny Rosalina¹
Nur Wisma³
Oktarifaldi⁴
Soni Nopembri⁴

¹ Universitas Negeri Padang, (Indonesia)
² STKIP Ahlussunnah Bukittinggi, (Indonesia)
³ Universitas Sriwijaya, (Indonesia)
⁴ Universitas Negeri Yogyakarta, (Indonesia)

Corresponding author:
Ibnu Andli Marta
ibnuandlimarta@fik.unp.ac.id

Received: 02-11-25
Accepted: 10-02-26

How to cite in APA

Marta, I. A., Syafnita, T., Suriani, A., Hachi, I., Rosalina, V., Wisma, N., Oktarifaldi, O., & Nopembri, S. (2026). Analysis of motor competence in elementary school students aged 7 to 12 years: comparison between students in the highlands and lowlands in Indonesia. *Retos*, 78, 909-918. <https://doi.org/10.47197/retos.v79.118022>

Abstract

Introduction: Motor competence should be optimized at an early age. At this level, students have more opportunities to explore and develop their motor coordination through the PE subject and extracurricular activities. However, studies indicate that many Indonesian teachers are unaware of this potential due to limited access to measurement instruments and methods. Additionally, motor development may differ depending on where the students live.

Objective: This study analyzed motor competence among 7-12-year-old individuals attending elementary school and compared those residing in lowland and highland areas.

Methodology: The study employed a cross-sectional design involving 360 elementary school samples (189 males and 171 females) from various cities and regencies in West Sumatra. Data were analyzed by evaluating motor competence using the Körperkoordinations Test für Kinder (KTK3+EHC), which included balance beam tests, lateral movements, side jumps, and hand-eye coordination tasks. This analysis was facilitated by IBM SPSS version 25.

Discussion: Results revealed that the overall mean motor competence scores for students in West Sumatra were 14.45 (SD = 3.4). Based on residence, students' mean scores in lowland areas were lower (M = 13.81, SD = 2.9) than those in the highland (M = 15.17, SD = 3.8). This difference was statistically significant not only between lowland and highland areas ($p < 0.000$), but also between male ($p < 0.000$) and female students ($p < 0.030$).

Conclusion: the findings indicate that motor competence is higher among highland students than those in lowland areas. The difference also applied across gender, with males performing better than females in both regions.

Keywords

Motor coordination; school location; elementary school students; motor competence.

Resumen

Introducción: La competencia motriz debe optimizarse a una edad temprana. A esta edad, los estudiantes tienen más oportunidades de explorar y desarrollar su coordinación motora a través de la asignatura de Educación Física y las actividades extracurriculares. Sin embargo, algunos estudios indican que muchos docentes indonesios desconocen este potencial debido al acceso limitado a instrumentos y métodos de medición. Además, el desarrollo motor puede variar según el lugar de residencia de los estudiantes.

Objetivo: Este estudio analizó la competencia motora entre individuos de 7 a 12 años que asisten a la escuela primaria y comparó a aquellos que residen en zonas bajas y altas.

Metodología: El estudio empleó un diseño transversal con una muestra de 360 alumnos de primaria (189 varones y 171 mujeres) de diversas ciudades y distritos de Sumatra Occidental. Los datos se analizaron evaluando la competencia motora mediante el Test de Coordinación Corporal para Niños (KTK3+EHC), que incluyó pruebas de equilibrio, movimientos laterales, saltos laterales y tareas de coordinación ojo-mano. Este análisis se realizó con el software IBM SPSS versión 25.

Discusión: Los resultados revelaron que la puntuación media general de competencia motora para los estudiantes en Sumatra Occidental fue de 14,45 (DE = 3,4). Según el lugar de residencia, las puntuaciones medias de los estudiantes en las zonas bajas fueron inferiores (M = 13,81, DE = 2,9) que las de los estudiantes en las zonas altas (M = 15,17, DE = 3,8). Esta diferencia fue estadísticamente significativa no solo entre las zonas bajas y altas ($p < 0,000$), sino también entre los estudiantes varones ($p < 0,000$) y mujeres ($p < 0,030$).

Conclusión: Los resultados indican que la competencia motora es mayor entre los estudiantes de zonas montañosas que entre los de zonas bajas. Esta diferencia también se observó entre géneros, con mejores resultados de los varones que de las mujeres en ambas regiones.

Palabras clave

Coordinación motora; ubicación escolar; estudiantes de primaria; competencia motora.



Introduction

Motor competence, often characterized by good motor coordination, is believed to be a primary predictor for an individual to perform a movement successfully. Numerous studies have shown that coordination skills are a foundational element for achieving motor competence. These skills contribute to enhanced manipulative abilities involving objects (such as a ball) using both upper and lower limbs (Oktarifaldi et al., 2024; Matos et al., 2022). Supriatna and Suhairi (2021) explain that movement competence is part of the ability to organize harmonious movement among body parts, which is related to bodily control skills, known as motor skills. It is a complex skill that involves controlling and synchronizing movements and is essential as primary skills to master specific movements in some sports disciplines (Braumann & Stiller, 2010). Faber et al. (2018) explain that movement competence results from the combined performance of muscle, bone, and joint qualities in producing effective and efficient movement. This competence is essential in daily life. Coordination abilities support the mastery of movement skills, such as eye-foot, eye-hand, and hand-eye-foot coordination. When these elements are well integrated, individuals find it easier to complete movement tasks (Zhang et al., 2023).

Motor competence should be developed from an early age (Freitas et al., 2015; Henrique et al., 2018; van der Fels et al., 2015). Scholars believe that individuals with good motor competence find it easier to learn and execute movements optimally (Marta et al., 2023; Oktarifaldi et al., 2019). For this reason, nurturing these abilities from an early age is more than a goal; it is the primary mission of physical education programs designed to enhance movement (Jukic et al., 2019; Vandorpe et al., 2011). They require full development across all stages so that previous training or learning experiences provide a foundation for further development in subsequent stages. Motor competence results from developmental processes through active student participation in physical activities (Rodrigues et al., 2015). It is not only a consequence of physiological changes, as environmental factors are also important in developing fundamental motor skills (Duarte et al., 2021).

Determining the best period for developing physical qualities is essential for implementing physical education programs. Scholars believe that the elementary school age is ideal for developing most motor skills that establish the foundation of movement success and coordination (Lagunes-Carrasco et al., 2022; Jarvis et al., 2022; Oktarifaldi et al., 2024). According to Pesce Ibarra (2018), this age represents a 'golden window' for brain development, where the nervous system is most receptive to learning new movements. Thus, it is viewed as a key predictor and influential factor in building and developing children's motor competence and promoting quality physical activity. To some extent, strong movement abilities are seen as predictors of children's potential for future achievements in sports (Mardiansyah et al., 2023; Pion, 2015).

Scholars argue that motor competence will improve if consistently practiced in both structured and unstructured ways at the elementary school level. For example, continuous structured physical activity during childhood promotes the development of locomotor skills, which can improve children's overall movement coordination (Gråstén et al., 2022). Moreover, at this level, students have ample opportunities to participate in and try various movements provided through Physical Education (PE), physical and sports activities, and extracurricular activities (De Bosscher et al., 2009; Nopembri & Sugiyama, 2021). This is evidenced by a comparative study showing that students in sports classes demonstrate higher motor competence than those in non-sports classes (Oktarifaldi et al., 2024).

However, a child's physical environment has a significant impact on their development of motor competence. For example, West Sumatra Province, a large province in Indonesia, is marked by mountainous and coastal regions with a diverse population and balanced distribution between highlands and lowlands. This province presents a unique research interest because these demographic and geographic differences should be considered when designing learning programs. Differences in geographic locations (e.g. urban-rural and highland-lowland) may lead to variations in physical conditions, skills, readiness, and personal health. Additionally, local environmental factors influence children's physical condition, competence, and health (Syaifuddin & Juanita, 2016).

Empirical studies show differences in characteristics, social traits, and mindsets among elementary students in rural and urban areas. Few have compared academic performance between rural and urban elementary students, including those residing in highlands and lowlands (Aisah et al., 2022). Highlands are mountainous regions at higher altitudes than lowlands or coastal areas, with cooler temperatures



than coastal regions. Lowlands are generally lower areas at altitudes similar to the surrounding areas (Fida & Candra, 2020). Differences in temperature and other indicators between highlands and lowlands may influence student's physical abilities and motor competence. Therefore, research suggests that there are differences in locomotor and manipulative competencies among elementary students depending on geographical location and residential environment (Pamungkas et al., 2022).

Despite the clear influence of these environmental factors, a gap remains between theoretical knowledge and educational practice in the field. Preliminary observations and interviews with PE teachers at elementary schools in West Sumatra uncover the practical issues. Although many teachers understand the importance of motor competence, they are unaware that it effectively develops during the elementary school years. This is largely due to their lack of understanding of how to evaluate and pick a valid measurement instrument.

To address this gap, it is essential to first establish empirical evidence of how West Sumatra's unique demographic and geographic diversity, specifically the contrast between highland and lowland environments, affects student outcomes. This study, therefore, aims to compare the motor competence of students in highland and lowland areas in West Sumatra. These findings are meant to support and empower school professionals in helping their students move better, as well as stakeholders or policymakers who design physical education programs.

Method

A quantitative cross-sectional study was employed by observing and examining data from a group of participants at a one particular moment (Wang & Cheng, 2020). It involved participants aged 7 to 12 years from lower-grade elementary school students.

Participants

These participants were gathered from five public schools across four cities and regencies in West Sumatra, Indonesia. They were recruited randomly, yielding a total of 360 students (189 males and 171 females). Based on areas, 91 male and 79 female students were obtained from the highland, while the lowland group included 98 males and 92 females.

Procedure

In this study, the Körperkoordinations Test für Kinder (KTK3+EHC) was employed to measure students' motor competence (Matos et al., 2022; Mardiansyah et al., 2023). This instrument includes four components: (1) balance beam, where students walk backward on three balance beams (3 meters in length, with widths of 3 cm, 4.5 cm, and 6 cm, respectively); (2) moving sideways, where students shift laterally on two 25 cm x 25 cm platforms; (3) jumping sideways, where students jump to the left and right using both feet across a small dividing beam measuring 3 cm x 1 cm; and (4) eye-hand coordination. To evaluate this coordination, participants were asked to toss a tennis ball against the wall with one hand and catch the rebound with the other. Target distances and markers were predetermined beforehand.

Data analysis

Descriptive statistics were calculated to provide an overview of the performance profiles across both geographical areas. After testing data normality, a t-test was conducted to examine if the difference is statistically significant. In this analysis, the study examined not only differences between areas but also between genders. The data were normally distributed if the results of the Shapiro-Wilk statistical processing showed $p < 0.050$. Thus, it can be continued for further testing. All statistical processing was facilitated by IBM SPSS Statistics version 25. In terms of ethical conduct, this study has been approved and received research recommendations from Padang State University (reference number: 2505/UN.35.15/PL/2024) in June 2024.



Results

Research result

This section presents descriptive findings used to characterize the study's the participants. Overall, the mean motor competence score for 360 students was $M = 14.45$ ($SD = 3.4$). A total of 177 (49%) students were in the above-average group, while the remaining 183 (51%) fell in the below-average group. Based on gender, male students had a higher motor coordination score ($M = 15.40$, $SD = 3.4$) than female students ($M = 13.40$, $SD = 3.0$). Despite a broad performance range spanning from a minimum of 5 to a maximum of 26, the overall motor competence for both genders across lowland and highland remained within the average category. For a more detailed breakdown, Table 1 presents the data by highland and lowland groups, with a distinction between male and female students.

Table 1. Descriptive statistics of motor competence group data

GROUP		N	Average	Std	Min	Max	RATING
Highland	General	170	15,17	3.8	5	26	Average
	Male	91	16,05	3.7	7	26	Average
	Female	79	14,15	3.6	5	23	Below Average
Lowland	General	190	13,81	2.9	6	22	Below Average
	Male	98	14,80	3.1	8	22	Below Average
	Female	92	12,76	2.4	7	19	Below Average

Another interesting finding from Table 1 is the evidence that students from highland areas have a higher mean competence score than those from lowland areas. Male students consistently outperformed female students within each group. Highland male students had the highest mean competence scores, while lowland female students had the lowest, falling into the below-average category. Further individual scores are detailed in Table 2.

Table 2. Motor coordination scores for highland and lowlands students (Overall, Male, and Female)

MOTOR COORDINATION SCOREs	Highland			Lowland			DESCRIPTIVE RATING
	All	M	F	All	M	F	
> 23	3	3	0	0	0	0	Very Superior
21 - 23	11	8	3	4	4	0	Superior
18 - 20	29	19	10	18	15	3	Above Average
15 - 17	61	35	26	51	37	19	Average
12 - 14	39	16	23	76	31	41	Below Average
8 - 11	24	9	15	39	11	28	Low
< 8	3	1	2	2	0	2	Very Low

As shown in Table 2, 29 highland students scored above average, 39 scored below average, and 61 scored within the average range. Among highland male students, 19 scored above average, 16 scored below average, and 35 scored within the average range. For highland females, 10 scored above average, 23 scored below average, and 26 scored within the average range. The highest score recorded was 26, and the lowest was 5. In the lowlands, a total of 18 lowland students scored above average, 76 scored below average, and 51 scored within the average range. Among lowland males, 15 scored above average, 31 scored below average, and 37 scored within the average range. For lowland females, 3 scored above average, 41 scored below average, and 19 scored within the average range. The highest score recorded was 22, and the lowest was 6.

Table 3. Comparing the motor coordination abilities of highland and lowland students

Descriptive Rating	Highland (%)	Lowland (%)
Very Superior	1.76	0.00
Superior	6.47	2.11
Above Average	17.06	9.47
Average	35.88	26.84
Below Average	22.94	40.00
Low	14.12	20.53
Very Low	1.76	1.05



Table 3 above illustrates that in the "Very Superior" category, highland students slightly outperform lowland students. Highland students also excelled in the "Superior," "Above Average," and "Average" categories compared to lowland students. Conversely, in the "Below Average" and "Low" categories, highland students were significantly fewer in number, indicating that highland students generally possess higher individual and group motor coordination scores than lowland students.

After presenting the participants' overall differences (both in area and gender), a t-test was conducted to determine whether differences between highland and lowland students were significant. The results revealed a significant difference in motor competence, with highland students outperforming their lowland counterparts ($p < 0.05$). Furthermore, there was a significant difference between highland and lowland male students ($p < 0.05$), confirming a difference in average motor coordination scores between the groups. Similarly, female students from highland areas showed significantly higher motor coordination scores than their lowland counterparts ($p < 0.05$).

Table 4. Independent samples test: Motor coordination between highland and lowland students

Result		F	Sig.	t	df	Sig. (2-tailed)
Motor Coordination	Equal variances assumed	7.371	0.007	3.846	358	0.000
	Equal variances not assumed			3.792	316	0.000

The independent samples test results in Table 4 for highland and lowland students yielded an F-value of 7.371 and a t-value of 3.846, with a two-tailed significance level of 0.000. These statistical indicators confirm a significant difference in motor competence, with students in highland regions demonstrating superior coordination capabilities compared to their lowland counterparts.

Table 5. Independent samples test: Motor coordination between male highland and lowland students

Result		F	Sig.	t	df	Sig. (2-tailed)
Motor Coordination	Equal variances assumed	1,189	0.277	2,550	187	0.012
	Equal variances not assumed			2,532	174,42	0.012

The independent samples test results in Table 5 for male students from highland and lowland areas yielded an F-value of 1.189 and a t-value of 2.550, with a two-tailed significance level of 0.012. This finding indicates a statistically significant difference in motor coordination between male highland and lowland students, with highland students demonstrating superior coordination abilities.

Table 6. Independent samples test: Motor coordination between female highland and lowland students

Result		F	Sig.	t	df	Sig. (2-tailed)
Motor Coordination	Equal variances assumed	13,871	0.000	3,027	169	0.003
	Equal variances not assumed			2.935	130,42	0.004

The independent samples test results in Table 6 for female students from highland and lowland areas yielded an F-value of 13.871 and a t-value of 3.027, with a two-tailed significance level of 0.003. This result indicates a statistically significant difference in motor coordination between female highland and lowland students, with highland students demonstrating significantly higher motor competence than their lowland counterparts.

Discussion

Motor coordination is fundamental in movement skills because individuals with competent motor coordination tend to exhibit proficient basic movement skills (Matos et al., 2022). Unfortunately, the results of this study revealed that students' overall motor competence in West Sumatra fell within the average



category. Among the 360 students, only 3 exhibited very superior motor competence, while the remaining were in the average or below-average categories. When we divide the participants into two groups, it is observed that students' motor competence remains below average. In terms of student's residing area, this study found differences in learning outcomes, specifically motor competence, between students residing and attending school in both highland and lowland areas. In particular, students from highland areas have better coordination skills compared to those from lowland regions. These differences were significant between students from these two regions. This finding suggests that the residential environment is influential in stimulating children's motor development (Zhang et al., 2023).

By gender, lowland-area female students in this study have the lowest coordination abilities. These results are consistent with existing literature indicating that male students typically demonstrate superior motor coordination proficiencies compared to their female counterparts, particularly in locomotor and object-control abilities. Between the ages of 6 and 10, boys excel in eye-hand coordination (Platvoet et al., 2018). According to Santos et al. (2020), male students tend to excel relative to female students across all locations studied, including Peru, the Amazon, and other countries such as Indonesia. This is likely because male students engage in physical activities with greater intensity than female students.

In terms of the participants' age, older students are assumed to have more optimal nervous system processes (Bompa & Gregory, 2019). De Souza et al. (2014) confirm that children with good motor coordination at age 6 are more likely to be active and skillful in physical activities by age 10. Although age and maturation support better coordination, Freitas et al. (2016) suggest that maturity alone does not naturally enhance students' motor coordination competence. Social and cultural factors also impact coordination abilities, as movement culture and physical activity have a substantial influence on motor skill development, including coordination (Ré et al., 2018).

The superiority of highland students can be attributed to their unique geographical and rural settings. Qualitative observations indicate that highland students have more chances to engage in physical activity than their peers in the lowlands. The highland and rural environments force them to face extreme geographical conditions, making highland students more independent and accustomed to physical activity. In contrast, lowland students may face different environmental constraints or sedentary lifestyle habits. Therefore, these findings can be an authentic reflection of West Sumatra's regional context.

As the student's motor competence in this study was low, it provides recommendations for all teachers to improve it. Teachers can take action, for example, by implementing variations of basic movement-based games in the PE subject at both the beginning and the end of learning activities (Iryanti et al., 2024). Analysis and literature reviews indicate that elementary school children need to actively develop responsiveness and reaction speed, which are essential for advancing motor coordination. Whether through eye-hand or foot coordination, integrating these movements into physical activities effectively enhances PE learning (Zhang et al., 2023). Additionally, optimal motor coordination will benefit students in learning specialized sport movements. Dane et al. (2008) highlight that, aside from technique evaluation, the most important criteria in sports involve assessing individual potential based on motor coordination skill level.

Addressing field issues requires teachers, coaches, and parents to enhance students' coordination abilities. This study identifies a critical link between pedagogical quality and student outcomes, suggesting that motor competence is partly shaped by the teacher's ability to facilitate structured and effective learning experiences. and implement them effectively (NASPE, 2014). Unfortunately, many PE teachers in West Sumatra lack the knowledge to pick valid measurement instruments or identify the "critical window" for development. In fact, teachers are agents of change and are responsible for developing physical literacy in the school environment; they must have adequate knowledge, skills, and practices (Barratt et al., 2024). Hence, it is important to equip them with Fundamental Movement Skills (FMS) to develop students' motor competencies (Salters & Scharoun Benson, 2022).

To improve these outcomes, teachers can take several actions. For example, coordination training can be implemented by offering varied and combined movement forms, including sport-specific movements (Marta & Oktarifaldi, 2020; Spieszny et al., 2024). Findings by Trecroci et al. (2015), for instance, suggest that integrating jumping rope exercises at the beginning of training sessions over eight weeks effectively improves motor coordination and balance. Direct learning methods (demonstrations) can enhance stu-



dents' motor skills and are particularly effective for students with either high or low coordination abilities in physical Education and specific sports training (Resanto & Rahayu, 2013). In addition, evidence suggests that ten minutes of consistent bilateral coordination training can improve students' focus and attention more effectively than a regular PE subject of the equal length (Fernandes et al., 2016). Similarly, the use of manipulative, tool-based exercises has proven successful in developing both hand and foot coordination (Nadia et al., 2023).

Furthermore, alternative approaches, such as a hybrid program that combines school and home settings, or even video-based learning via YouTube platforms, are believed to foster children's motor development through tailored training based on student characteristics (Byburtlu et al., 2024; Friskawati & Supriadi, 2022). In addition, physical education teachers must incorporate high-quality, important dimensions into sports lessons by providing developmentally appropriate materials and quality demonstrations (Chen et al., 2016). Continuous implementation of materials in physical Education is needed because motor competence tends to decrease with increasing age of the child (Chovanová et al., 2023; Oktarifaldi et al., 2024). These findings are significant and are expected to help develop children's motor coordination, both in physical Education and specialized sports, for optimal movement.

Conclusions

The development of motor coordination is not naturally related to an individual's maturity but is influenced by the living environment, including school location, peer support, family, and educational programs that encourage physical activity. In this study, male students outperformed female students in both highland and lowland areas. Furthermore, students residing in highland regions generally exhibit better motor coordination, both individually and as a group, compared to those living in lowland areas. To improve students' outcomes, this study recommends structured coordination training at school to significantly enhance students' motor coordination. While this study provides essential baseline data, the results cannot yet be fully generalized across all of Indonesia. A further study is still needed to investigate teachers' skills in designing learning approaches that are relevant to students' conditions in elementary schools (Kurniawan et al., 2023). Further qualitative and quantitative research with larger samples and broader regional coverage is needed to confirm the impact of geography on motor competence.

Acknowledgements

The authors express gratitude to Padang State University, particularly the university's research and community service department, for providing financial support for this research in the 2024 fiscal year. Additionally, we thank all students, practitioners, and policymakers who were willing to participate in this study. Special appreciation is also given to the research team for their assistance in collecting data on students' motor coordination in five schools located in the highland and lowland areas of West Sumatra Province.

References

- Aisah, L. N., Muharram, N., Kurniawan, W. P., & Pratama, B. A. (2022). Perbandingan prestasi belajar peserta didik yang tinggal di Desa dan Kota pada masa Pandemi Covid-19. *Sriwijaya Journal of Sport*, 1(3), 141-150. doi.org/10.55379/sjs.v1i3.399
- Barratt, J., Dudley, D., Stylianou, M., & Cairney, J. (2024). A conceptual model of an effective early childhood physical literacy pedagogy. *Journal of Early Childhood Research*. doi.org/10.1177/1476718X231219580
- Bompa, T. O., & Gregory, Gh. (2019). *Periodization Theory and Methodology of Training Fifth Edition*. In *Human Kinetics*.
- Braumann, K.-M., & Stiller, N. (2010). *Bewegungstherapie bei internistischen Erkrankungen*. In Springer.



- Byburtlu, M. B., Genç, A., & Ünal, F. (2024). The effects of hybrid physical activity program on various motor skills in primary school children. *Pedagogy of Physical Culture and Sports*, 28(5), 456–467.
- Chen, W., Mason, S., Hypnar, A., & Bennett, A. (2016). Assessing Motor Skill Competency in Elementary School Students: A Three-Year Study. In *Journal of Sports Science and Medicine* (Vol. 15). <http://www.jssm.org>
- Chovanová, E., Majherová, M., & Bendíková, E. (2023). Age- and Gender-Specific Levels and Differences in Children's Gross Motor Coordination During Prepuberty. *Physical Activity Review*, 11(2), 86–93. doi.org/10.16926/par.2023.11.24
- Dane, S., Hazar, F., & Tan, Ü. (2008). Correlations between eye-hand reaction time and power of various muscles in badminton players. *International Journal of Neuroscience*, 118(3), 349–354.
- De Bosscher, V., De Knop, P., Van Bottenburg, M., Shibli, S., & Bingham, J. (2009). Explaining international sporting success: An international comparison of elite sport systems and policies in six countries. *Sport Management Review*, 12(3), 113–136.
- De Souza, M. C., De Chaves, R. N., Lopes, V. P., Malina, R. M., Garganta, R., Seabra, A., & Maia, J. (2014). Motor coordination, activity, and fitness at 6 years of age relative to activity and fitness at 10 years of age. *Journal of Physical Activity and Health*, 11(6), 1239–1247. doi.org/10.1123/jpah.2012-0137
- Dinafi, Y., Saputra, A., & Muzaffar, A. (2023). Comprehensive study on elementary school children's 24-hours movement guidelines in physical education class. *Journal Sport Area*, 8(3), 371–379. [doi.org/10.25299/sportarea.2023.vol8\(3\).12928](https://doi.org/10.25299/sportarea.2023.vol8(3).12928)
- Duarte, M. G., Nobre, G. C., Gomes, T. V. B., & Benda, R. N. (2021). Fundamental motor skill performance of indigenous and nonindigenous children. *Journal of Motor Learning and Development*, 9(1), 14–27. doi.org/10.1123/JMLD.2019-0050
- Faber, I. R., Pion, J., Munivrana, G., Faber, N. R., & Nijhuis-Van der Sanden, M. W. G. (2018). Does a perceptuomotor skills assessment have added value to detect talent for table tennis in primary school children? *Journal of Sports Sciences*, 36(23), 2716–2723. doi.org/10.1080/02640414.2017.1316865
- Fernandes, V. R., Ribeiro, M. L. S., Melo, T., Maciel-Pinheiro, P. de T., Guimarães, T. T., Araújo, N. B., Ribeiro, S., & Deslandes, A. C. (2016). Motor coordination correlates with academic achievement and cognitive function in children. *Frontiers in Psychology*, 7(MAR). doi.org/10.3389/fpsyg.2016.00318
- Fida, A., & Candra, A. (2020). Perbandingan Kebugaran Jasmani Siswa Usia 13-15 Tahun Pada Daerah Pesisir Pantai dan Daratan Tinggi. *Sport-Mu Pendidikan Olahraga*, 1(1).
- Freitas, D. L., Lausen, B., Maia, J. A., Lefevre, J., Gouveia, É. R., Thomis, M., Antunes, A. M., Claessens, A. L., Beunen, G., & Malina, R. M. (2015). Skeletal maturation, fundamental motor skills and motor coordination in children 7–10 years. *Journal of Sports Sciences*, 33(9), 924–934. doi.org/10.1080/02640414.2014.977935
- Freitas, D. L., Lausen, B., Maia, J. A. R., Gouveia, É. R., Thomis, M., Lefevre, J., Silva, R. D., & Malina, R. M. (2016). Skeletal maturation, body size, and motor coordination in youth 11-14 years. *Medicine and Science in Sports and Exercise*, 48(6), 1129–1135. doi.org/10.1249/MSS.0000000000000873
- Friskawati, G. F., & Supriadi, D. (2022). Video analysis with youtube platform for Physical Education, Health, and Recreation students's Higher Order Thinking Skills (HOTs). *Journal Sport Area*, 7(1), 96–103. [doi.org/10.25299/sportarea.2022.vol7\(1\).7737](https://doi.org/10.25299/sportarea.2022.vol7(1).7737)
- Gråstén, A., Kolunsarka, I., Huhtiniemi, M., & Jaakkola, T. (2022). Developmental associations of actual motor competence and perceived physical competence with health-related fitness in schoolchildren over a four-year follow-up. *Psychology of Sport and Exercise*, 63. doi.org/10.1016/j.psychsport.2022.102279
- Henrique, R. S., Bustamante, A. V., Freitas, D. L., Tani, G., Katzmarzyk, P. T., & Maia, J. A. (2018). Tracking of gross motor coordination in Portuguese children. *Journal of Sports Sciences*, 36(2), 220–228. doi.org/10.1080/02640414.2017.1297534
- Iryanti, D., Juditya, S., Agusni Zakaria, D., Hambali, S., Pasundan, S., Utara, C., Barat, J., & Juditya STKIP Pasundan, S. (2024). Physical education games model to improve physical literacy skills of children. *Altius: Jurnal Ilmu Olahraga Dan Kesehatan*, 13(2), 213–226. doi.org/10.36706/altius.v13i2.72



- Jarvis, S., Rainer, P., & Ganesh, S. (2022). Fundamental movement proficiency of Welsh primary school children and the influence of the relative age effect on skill performance—implications for teaching. *Education 3-13*, 51(6), 907–918. doi.org/10.1080/03004279.2022.2027993
- Jukic, I., Prnjak, K., Zoellner, A., Tufano, J. J., Sekulic, D., & Salaj, S. (2019). The importance of fundamental motor skills in identifying differences in performance levels of u10 soccer players. *Sports*, 7(7). doi.org/10.3390/sports7070178
- Kurniawan, W. R., Hartono, M., & Wijayanti, D. G. S. (2023). Post-pandemic face-to-face learning: Perspectives from physical education teachers. *Journal Sport Area*, 8(1), 87–94. doi.org/10.25299/sportarea.2023.vol8(1).10965
- Lagunes-Carrasco, J. O., Carranza-García, L. E., López-García, R., Legaz-Arrese, A., Navarro-Orocio, R., & Ramírez-López, E. (2022). A three-compartment model of body composition for validating an anthropometric equation to estimate fatness in football players. *Retos*, 46. doi.org/10.47197/retos.v46.93737
- Mardiansyah, A., Syafruddin, & Bakhtiar, S. (2023). Assessment of Motor Competence In Indonesian Elementary School Children Using the Körperkoordinationstest Für Kinder (KTK3+) (Body Coordination Test for Children). *Journal of Physical Education and Sport @ (JPES)*, 23(10), 2632–2641. doi.org/10.7752/jpes.2023.10301
- Marta, I. A., & Oktarifaldi, O. (2020). Koordinasi Mata-Kaki dan Kelincahan terhadap Kemampuan Dribbling Sepakbola. *Gelanggang Olahraga: Jurnal Pendidikan Jasmani Dan Olahraga (JPJO)*, 4(1), 1–14. doi.org/10.31539/jpjo.v4i1.1201
- Marta, I. A., Oktarifaldi, O., Hatchi, I., Wisma, N., Rosalina, V., Nopembri, S., Erhan Orhan, B., Kurnaz, M., & Shahril, M. I. bin. (2024). Characteristics of gross motor skills of elementary school students aged 7 and 8 years: a cross-sectional study. *Retos*, 59. doi.org/10.47197/retos.v59.107293
- Marta, I. A., Oktarifaldi, O., & Wisma, N. (2023). Analysis of motor coordination abilities of students: Comparative study of students in urban and rural areas. *Jurnal SPORTIF : Jurnal Penelitian Pembelajaran*, 9(3), 415–436. doi.org/10.29407/js_unpgri.v9i3.21218
- Matos, R., Monteiro, D., Rebelo-Gonçalves, R., Coelho, L., Salvador, R., Antunes, R., Mendes, D., & Amaro, N. (2022). Wall Drop Punt Kick & Catch: Contributions towards the creation of a new gross manipulative coordination test. *International Journal of Sports Science and Coaching*, 17(3), 590–598. doi.org/10.1177/17479541211037556
- Nadia, Bakhtiar, S., Syahputra, R., Oktarifaldi, & Pratama Putri, L. (2023). Study of Sports Talent (Characteristics of Elite and Non-Elite Junior Tennis Athletes In Jambi City Based On Gender). *Halaman Olahraga Nusantara (HON)*, 6(II), 581–582. doi.org/10.31851/hon.v6i2.10962
- NASPE. (2014). *Moving into the future: National standards for physical Education*. Reston, VA :, 1–66.
- Nopembri, S., & Sugiyama, Y. (2021). Assessing psychosocial skills and negative emotional states of elementary school students in Yogyakarta Area. *International Journal of Instruction*, 14(3), 59–72. doi.org/10.29333/iji.2021.1434a
- Oktarifaldi, Nopembri, S., Yudianto, & Bin Shahril, M. I. (2024). The fundamental motor skills and motor coordination performance of children in West Sumatera Province, Indonesia. *Pedagogy of Physical Culture and Sports*, 28(1), 4–15. doi.org/10.15561/26649837.2024.0101
- Oktarifaldi, O., Marta, I. A., Nugroho, W. A., Hardi, V. J., & Utomo, S. (2024). Keterampilan Gerak Dasar Kelompok Usia 7 sampai 9 Tahun Siswa Sekolah Dasar. *Jendela Olahraga*, 09(1), 10–23. doi.org/10.26877/jo.v9i1.17646
- Oktarifaldi, O., Syahputra, R., & Putri, L. P. (2019). Pengaruh Kelincahan, Koordinasi Dan Keseimbangan Terhadap Kemampuan Lokomotor Siswa Usia 7 Sampai 10 Tahun. *Jurnal MensSana*, 4(2). doi.org/10.24036/jm.v4i2.117
- Pamungkas, R., Angga, P. D., & Wahyudi, U. (2022). Studi Perbandingan Kemampuan Gerak Lokomotor dan Manipulatif Dataran Rendah dan Dataran Tinggi Siswa SD. *JOLMA*, 2(2), 103. doi.org/10.31851/jolma.v2i2.6732
- Pesce Ibarra, L. S. (2018). NEURO FORUM Control of Movement Synchronization matters for motor coordination. *J Neurophysiol*, 119, 767–770. doi.org/10.1152/jn.00182.2017.-Using
- Pion, J. (2015). *The Flemish Sports Compass From sports orientation to elite performance prediction*. UNIVERSITEIT GENT : FACULTY OF MEDICINE AND HEALTH SCIENCES DEPARTMENT OF MOVEMENT AND SPORTS SCIENCES, 1–233. <http://www.universitypress.be>



- Platvoet, S., Faber, I. R., de Niet, M., Kannekens, R., Pion, J., Elferink-Gemser, M. T., & Visscher, C. (2018). Development of a Tool to Assess Fundamental Movement Skills in Applied Settings. *Frontiers in Education*, 3. doi.org/10.3389/feduc.2018.00075
- Ré, A. H. N., Logan, S. W., Cattuzzo, M. T., Henrique, R. S., Tudela, M. C., & Stodden, D. F. (2018). Comparison of motor competence levels on two assessments across childhood. *Journal of Sports Sciences*, 36(1), 1–6. doi.org/10.1080/02640414.2016.1276294
- Resanto, S., & Rahayu, S. (2013). Pengaruh Metode Pembelajaran dan Koordinasi Gerak Terhadap Hasil Belajar Permainan Bola Basket. In *JPES* (Vol. 1, Issue 2). doi.org/10.15294/JPES.V1I2.809
- Rodrigues, D., Leal Avigo, E., José, J., Barela, A., & Barela, J. A. (2015). Proficiency of fundamental motor skills in children of a public school in the city of São Paulo. In *Brazilian Journal of Motor Behavior Research Article Rodrigues, Avigo & Barela* (Vol. 9). doi.org/10.20338/bjmb.v9i1.53
- Salter, D., & Scharoun Benson, S. M. (2022). Perceptions and Use of Teaching Strategies for Fundamental Movement Skills in Primary School Physical Education Programs. *Children*, 9(2). doi.org/10.3390/children9020226
- Santos, C., Bustamante, A., Hedeker, D., Vasconcelos, O., Garganta, R., Katzmarzyk, P. T., & Maia, J. (2020). A multilevel analysis of gross motor coordination of children and adolescents living at different altitudes: the Peruvian Health and Optimist Growth Study. *Annals of Human Biology*, 47(4), 355–364. doi.org/10.1080/03014460.2020.1742378
- Spieszny, M., Wasacz, W., Kamys, Z., Ambrozy, T., Kasicki, K., Kapuscinski, P., & Rydzik, L. (2024). The impact of coordination training on motor skills in adolescent handball players aged 14–15 years: A randomized controlled trial. *Baltic Journal of Health and Physical Activity*, 16(4), Article10–Article10. doi.org/10.29359/BJHPA.16.4.10
- Supriatna, E., & Suhairi, M. (2021). Pengembangan bola soft untuk mengembangkan keterampilan teknik dasar dan koordinasi gerak bolavoli di sekolah dasar. *Multilateral : Jurnal Pendidikan Jasmani Dan Olahraga*, 20(2), 83. doi.org/10.20527/multilateral.v20i2.10302
- Syaifuddin, A., & Juanita, D. H. N. (2016). Perbandingan Kesehatan Pribadi Siswa SDN di Kota dengan MI di Desa (Studi Pada Siswa Kelas VI SD Model Terpadu Bojonegoro dan MI Muhammadiyah 18 Sumberrejo). *Jurnal Pendidikan Jasmani UNESA*, 171–176. <http://ejournal.unesa.ac.id/index.php/jurnal-pendidikan-jasmani/issue/archive>
- Trecroci, A., Cavaggioni, L., Caccia, R., & Alberti, G. (2015). Jump Rope Training: Balance and Motor Coordination in Preadolescent Soccer Players. *Journal of Sports Science & Medicine*, 792–798.
- van der Fels, I., Wierike, S. C. M., Hartman, E., Elferink-Gemser, M. T., Smith, J., & Visscher, C. (2015). Movement, cognition and underlying brain functioning in children. *Journal of Science and Medicine in Sport*, 18(6), 697–703. doi.org/10.33612/diss.109737306
- Vandorpe, B., Vandendriessche, J., Lefevre, J., Pion, J., Vaeyens, R., Matthys, S., Philippaerts, R., & Lenoir, M. (2011). The KörperkoordinationsTest für Kinder: Reference values and suitability for 6-12-year-old children in Flanders. *Scandinavian Journal of Medicine and Science in Sports*, 21(3), 378–388. doi.org/10.1111/j.1600-0838.2009.01067.x
- Wang, X., & Cheng, Z. (2020). Cross-Sectional Studies: Strengths, Weaknesses, and Recommendations. In *Chest* (Vol. 158, Issue 1, pp. S65–S71). Elsevier Inc. doi.org/10.1016/j.chest.2020.03.012
- Zhang, S., Hu, L., & Luo, B. (2023). An Empirical Study on the Effect of Sports Vision Training on Primary School Students' Motor Coordination
- Torres-Salinas, D. (2007). Design of a scientific information and evaluation system: Scientometric analysis of the research activity of the University of Navarra in the area of health sciences 1999-2005 [Unpublished doctoral thesis]. University of Navarra

Authors and translators' details:

Ibnu Andli Marta	ibnuandlimarta@fik.unp.ac.id	Author
Tisna Syafnita	tisnasyafnita@fip.unp.ac.id	Author
Ari Suriani	arisuriani@fip.unp.ac.id	Author
Itgo Hachi	hatchitgo@gmail.com	Author
Venny Rosalina	vennyrosalina@fbs.unp.ac.id	Author
Nur Wisma	nurwisma@fkip.unsri.ac.id	Author
Oktarifaldi	oktarifaldi.2022@student.uny.ac.id	Author/Translator's
Soni Nopembri	Soni_nopembri@uny.ac.id	Author

