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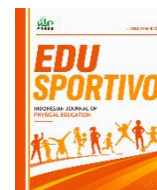
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REVIEW ARTICLE

Fundamental movement skills in Indonesian elementary school children: a systematic review of assessment, pedagogy, and motor competence

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ABSTRACT

Background: Fundamental movement skills (FMS) underpin motor competence, physical activity, and lifelong sport participation, yet evidence among Indonesian elementary school children remains fragmented. **Objectives:** his systematic review synthesised evidence on FMS assessment domains, pedagogical approaches, and motor competence in Indonesian elementary school children. **Methods:** Following PRISMA 2020, Scopus was searched for studies published from 2019 to 2024. Of 76 records identified, 16 studies met the eligibility criteria. Methodological quality was assessed using Joanna Briggs Institute tools, and findings were synthesised narratively. **Results:** Object-control and locomotor skills were assessed in 15 and 14 studies, respectively, whereas stability was examined in only one. Eleven studies evaluated pedagogical interventions, with game-based, traditional game, exergame, and play-based approaches generally associated with improved FMS. However, evidence strength was limited by methodological heterogeneity, including uncontrolled pre-post designs. Reported motor competence was predominantly low to moderate, while environmental context and PE teacher availability were more consistently documented influences than age or sex. **Conclusion:** Indonesian FMS research shows substantial domain imbalance, methodological heterogeneity, and generally low-to-moderate motor competence. Limited assessment of stability indicates incomplete representation of FMS. Future research should prioritise validated multidimensional FMS assessment, rigorous intervention designs, and standardised reporting to strengthen evidence-informed physical education practice.

Keywords: Fundamental movement skills; motor competence; elementary school children; physical education; Indonesia

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Authors' Contribution: a – Study Design; b – Data Collection; c – Statistical Analysis; d – Manuscript Preparation; e – Funds Collection



INTRODUCTION

Physical activity during childhood plays a fundamental role in promoting healthy growth and establishing lifelong health behaviours. Regular participation in physical activity contributes not only to physical fitness, bone health, and healthy body composition but also to cognitive development, psychological well-being, and social functioning (Janssen & Leblanc, 2010; Pate et al., 2019; WHO, 2019). Despite these well-established benefits, global evidence indicates that many children fail to achieve recommended levels of physical activity, particularly in low- and middle-income countries (Akwaboah et al., 2026). This growing concern has shifted attention toward the factors that enable children to participate confidently and consistently in movement experiences. Among these factors, competence in fundamental movement skills (FMS) has emerged as a critical prerequisite for sustained engagement in physical activity and lifelong participation in sport.

Fundamental movement skills represent the basic movement patterns that underpin children's motor competence and provide the foundation for more specialised and complex motor performance. These skills are commonly classified into three interrelated domains: locomotor skills, object-control skills, and stability skills, each contributing to children's ability to interact effectively with their physical environment (Barnett et al., 2008; Logan et al., 2018). Children who develop proficient fundamental movement skills are more likely to participate in physical activity, demonstrate higher perceived competence, and remain engaged in organised sport throughout childhood and adolescence (Barnett, Stodden, et al., 2016; Goodway et al., 2019; Lubans et al., 2016). Consequently, motor competence has become an important indicator of children's movement development and an increasingly relevant outcome for physical education research and practice.

A decade ago, most fundamental movement skill research simply described children's motor competence. Since then, the field has shifted toward identifying which assessment strategies and pedagogical approaches actually support motor development in school settings. A systematic review by Bolger et al. (2021) reported that children's overall FMS competence generally ranged from below average to average, indicating that motor competence remains a global concern despite growing recognition of its importance for lifelong physical activity and health. Building on this evidence, Lorenzo-Martínez et al. (2025) demonstrated that many children worldwide have not yet achieved mastery across several fundamental movement skills, emphasising the importance of regular assessment to identify developmental needs and guide appropriate educational interventions. More recently, Yin et al. (2025) showed through a systematic review and meta-analysis involving studies from 14 countries that well-designed school-based interventions can significantly improve children's fundamental movement skills when implemented with appropriate frequency, duration, and instructional quality. Across these three reviews, a shared international priority emerges: pairing thorough assessment across FMS domains with evidence-informed teaching practices to strengthen children's motor competence in primary education.

Research on fundamental movement skills in Indonesia has grown alongside these international developments, particularly among elementary school children. Researchers increasingly recognise that motor competence matters for children's health, their physical activity habits, and their broader learning. Nevertheless, national indicators continue to suggest that significant challenges remain. The 2021 National Sports Development Index reported that approximately 76% of the Indonesian population across 34 provinces was categorised as physically unfit, whereas only 34% met the

criteria for being physically active (Mutohir, 2022). These national figures have prompted Indonesian researchers to examine fundamental movement skills across different school settings, using a range of assessment instruments, pedagogical approaches, and research designs.

Low fundamental movement skill proficiency is not a uniquely Indonesian concern. In Singapore, Mukherjee et al. (2017) found that primary school children rated “average” to “below average” on locomotor skills and “poor” to “below average” on object-control skills after 2.5 years of primary school physical education. In Australia, Eather et al. (2018) reported that fewer than 5% of primary-school-aged girls achieved mastery in object-control skills such as striking, dribbling, throwing, and kicking, with mastery levels below 40% for most assessed subskills. In China, Gao et al. (2024) documented persistent proficiency gaps favoring boys over girls in object-control skills among more than 1,200 children. What remains specific to the Indonesian context, and largely undocumented, is how assessment domains, pedagogical approaches, and reported competence levels combine within a single body of evidence.

These Indonesian studies differ considerably in the assessment domains examined, measurement instruments employed, pedagogical approaches implemented, and reported motor competence outcomes, making it difficult to identify consistent patterns across the available evidence. Consequently, it remains unclear which fundamental movement skill domains have received the greatest research attention, which pedagogical practices have been most frequently implemented to support motor development, and how motor competence has been reported among Indonesian elementary school children. This review proposes an integrated synthesis framework that simultaneously links assessment domains, pedagogical practices, and motor competence, providing evidence unavailable from previous reviews. No existing synthesis has mapped these three dimensions together within a single Indonesian evidence base, limiting the ability of researchers, educators, and policymakers to develop evidence-informed strategies for strengthening fundamental movement skills in elementary physical education.

This review addresses the identified gap by integrating evidence on fundamental movement skills among Indonesian elementary school children within a unified analytical framework. Specifically, the review examines assessment domains, pedagogical practices, and reported motor competence to provide an integrated understanding of the current evidence base. Accordingly, the review was guided by the following research questions:

RQ1: Which fundamental movement skill domains have been investigated among Indonesian elementary school children?

RQ2: What pedagogical practices have been implemented to support the development of fundamental movement skills?

RQ3: What levels of motor competence have been reported among Indonesian elementary school children?

By addressing these research questions, this systematic review synthesises the available empirical evidence and identifies patterns, evidence gaps, and priorities for future research and physical education practice related to FMS development among Indonesian elementary school children.

METHODS

Review Design

This systematic review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines (Page et al., 2021). The review aimed to synthesise empirical evidence on fundamental

movement skills among Indonesian elementary school children, with a particular focus on assessment domains, pedagogical practices, and reported motor competence outcomes. Methodological quality was appraised using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist, as detailed in the Data Extraction and Quality Appraisal section below. This review was not prospectively registered in PROSPERO or the Open Science Framework (OSF). Although prospective registration is recommended to enhance transparency and reduce reporting bias, this review adhered to the PRISMA 2020 checklist throughout the entire review process to ensure methodological rigor and reporting completeness.

Eligibility Criteria

A modified PICOS framework was applied to define the study eligibility criteria before the literature search, ensuring a transparent and systematic approach to the selection process (Higgins et al., 2019). Given that this review aimed to synthesise empirical evidence on fundamental movement skills rather than evaluate intervention effectiveness, the Comparator element was deemed not applicable. The detailed eligibility criteria are summarized in Table 1.

Table 1. Article Selection Criteria

PICOS Element	Description	Inclusion Criteria	Exclusion Criteria
Population (P)	Target Participants	Indonesian elementary school children aged 6-12 years; typically developing children in school or educational settings.	The average age of participants was outside the elementary school range; clinical populations or children with special needs.
Intervention/ Interest (I)	Studies examining fundamental movement skills	Studies assessing FMS domains, motor competence, or pedagogical practices related to FMS development.	Studies unrelated to FMS or focusing exclusively on physical fitness or sport-specific performance.
Comparator (C)	Comparator Condition	Not applicable, as this review synthesises empirical evidence rather than evaluating intervention effectiveness.	Not applicable
Outcomes (O)	Primary review outcomes	Studies reporting at least one of the following: FMS assessment domains, pedagogical practices for FMS development, or motor competence levels.	Studies without FMS-related outcomes.
Study Design (S)	Eligible methodological designs	Cross-sectional, experimental, quasi-experimental, and observational studies published in Scopus-indexed peer-reviewed journals between January 2019 and December 2024, written in English or Indonesian.	Systematic reviews, meta-analyses, narrative reviews, conference proceedings, theses, dissertations, editorials, book chapters, and articles with inaccessible full texts.

Search Strategy

A systematic literature search was performed in Scopus considering studies published from January 2019 to December 2024. Scopus was the only bibliographic database employed because it contains the most complete and consistent index of peer-reviewed international literature on sport science, physical education and health-related themes. The search strategy employed controlled keywords and free-text terms combined with Boolean operators (AND, OR). Only full-text, peer-reviewed journal articles published in English were included. The entire search strategy is listed in Table 2.

Restricting the search to Scopus alone is acknowledged as a methodological limitation of this review. Studies indexed exclusively in Web of Science, SPORTDiscus, ERIC, or other regional databases may not have been captured. Future systematic reviews on this topic should expand database coverage to strengthen search comprehensiveness and reduce the risk of relevant study omissions.

Table 2. Search Results Based on Keywords Used in The Scopus Database

Database	Keywords	Publication Years	Filters Applied	Article Type
Scopus	("fundamental movement skill" OR "gross motor skill" OR "motor competence" OR "basic movement skills" OR "fundamental motor skills" AND "elementary school" OR "primary school" OR child)	2019-2024	Country/territory: Indonesia; Open access	Journal articles; English.

Study Selection

The Scopus search was conducted using the predefined keywords and refined with the following database filters: publication year limited to 2019-2024, country/territory limited to Indonesia, and document type limited to journal articles. This filtering strategy ensured that only Indonesian-context studies published within the target timeframe were retrieved. A total of 76 records were identified from the initial search. After duplicate records were removed, the retrieved studies were screened by title and abstract according to the predefined eligibility criteria. Screening and full-text eligibility assessment were conducted independently by two reviewers. Any disagreements arising during the screening process were resolved through discussion until consensus was reached. In cases where consensus could not be achieved, a third reviewer was consulted to make the final decision. Potentially relevant studies subsequently underwent full-text assessment, and only those meeting all inclusion criteria were included in the final synthesis. The study selection process is illustrated in **Figure 1**.

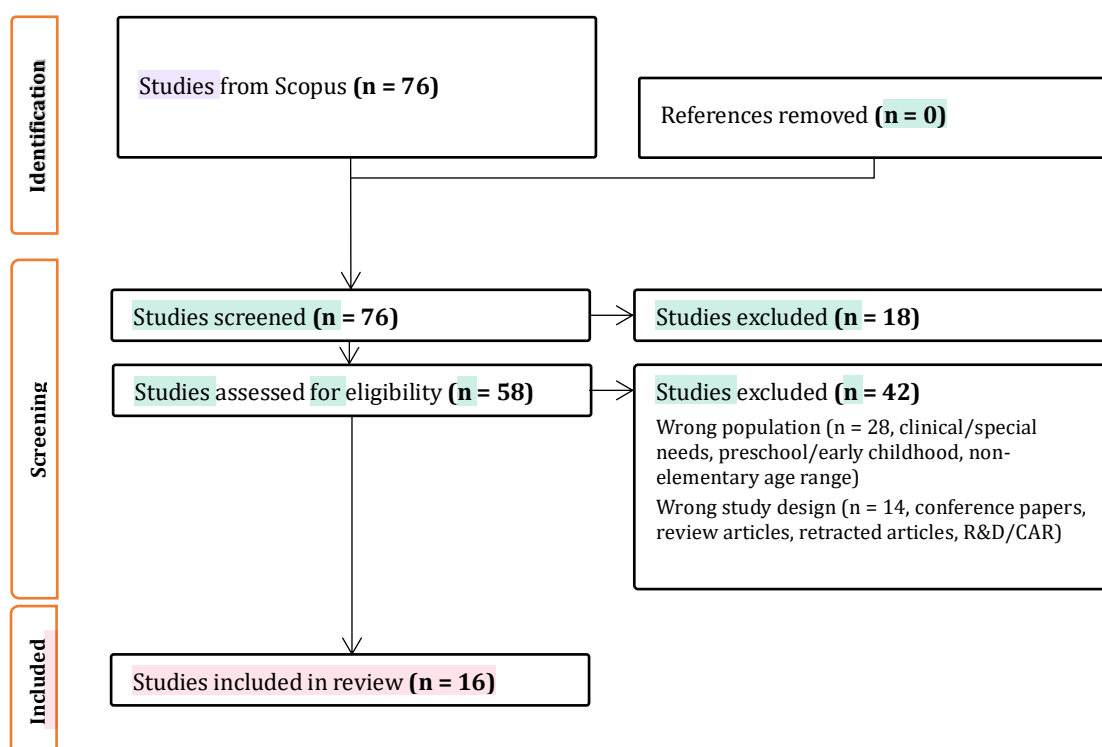


Figure 1. Diagram of the Study Screening Procedure

Data Extraction

A systematic literature search was conducted in the Scopus database to identify relevant studies published between January 2019 and December 2024. Scopus was selected as the sole bibliographic database due to its comprehensive indexing of peer-reviewed international and regional journals, including Indonesian-published research in the field of physical education and sport science. The use of a single database is acknowledged as a methodological limitation; however, this approach is consistent with established systematic review practices when the selected database provides sufficient disciplinary coverage and the rationale is transparently reported (Falagas et al., 2008).

Quality Assessment

The methodological quality of the 16 included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklists (Tufunaru et al., 2024). Two checklists were applied according to each study's research design: the Analytical Cross-Sectional Studies checklist (8 items) was applied to 5 studies, and the Quasi-Experimental Studies checklist (9 items) was applied to 11 studies. Studies employing classroom action research or research and development designs were excluded at the full-text eligibility stage, as these designs fall outside the predefined eligible methodological categories. Quality appraisal was conducted independently by two reviewers.

Disagreements in appraisal ratings were resolved through discussion, with a third reviewer consulted when necessary to reach a final decision. Overall, the majority of included studies demonstrated moderate methodological quality, with the most common limitations being the absence of randomisation, lack of control groups, and insufficient reporting of confounding factor control. Five studies employing pre-experimental one-group designs were rated as low quality due to high risk of bias. Table 3 summarises the appraisal results for all included studies. No studies were excluded solely on the basis of methodological quality, provided that they met the predefined eligibility criteria.

Table 3. Methodological Quality Appraisal of Included Studies

Study (Year)	Key Quality Indicators (summary of main domains)	Overall Risk of Bias / Study Quality
(Oktarifaldi, Nopembri, Yudanto, Izwan, et al., 2024)	Mixed-method design with cross-sectional quantitative component; FMS assessed via structured observation with TGMD-3; qualitative component triangulated quantitative findings; sampling criteria described but not randomly selected; confounding variables (SES, PA level) not controlled; measurement instrument validated.	Moderate risk of bias (Moderate quality).
(Mardiansyah et al., 2023)	Comparative cross-sectional design; MANOVA applied appropriately; sample size justified; age and sex modeled explicitly as factors alongside location; no randomisation; confounding variables (SES, PA level) not controlled; KTK3+ instrument reported with reliability (ICC 0.80-0.95).	Low-moderate risk of bias (Moderate-high quality).
(Wibowo et al., 2021)	Correlational design; TGMD-2 used for FMS assessment; PA measurement instrument described; sample representativeness limited to one school; confounding variables not addressed; no randomisation.	Moderate risk of bias (Moderate quality).
(Samodra et al., 2023)	Comparative cross-sectional; TGMD-2 applied consistently across two ecological settings (hill vs coastal); sample described but not randomly	Moderate risk of bias (Moderate quality).

Study (Year)	Key Quality Indicators (summary of main domains)	Overall Risk of Bias / Study Quality
	selected; confounding variables (SES, school resources) not controlled; measurement instrument validated.	
(Rizkyanto et al., 2023)	Two-group design (brain jogging vs direct instruction); pretest-posttest; no randomisation; baseline equivalence assumed but not empirically verified; blinding not reported; outcome measure described; sample size small.	Moderate risk of bias (Low-moderate quality).
(Bikalawan et al., 2024)	Pre-experimental; one-group pretest-posttest; TGMD-2 used; no control group; no blinding; baseline equivalence not empirically verified; sample size small; maturation effects cannot be ruled out.	High risk of bias (Low quality).
(Sukoco et al., 2022)	Two-group experimental; traditional sport intervention over 7 weeks; control group present; no randomisation; blinding not reported; instrument described; confounding factors not controlled.	Moderate risk of bias (Moderate quality).
(Satria et al., 2024)	Pre-experimental; one-group pretest-posttest; game-based PE intervention; manipulative skills assessed; no control group; no randomisation; blinding not reported; maturation effects cannot be ruled out.	High risk of bias (Low quality).
(Juliantine et al., 2022)	Two-group experimental; exergame vs control; 9-week intervention; TGMD-3 applied; randomisation process not described; blinding not reported; sample size adequate; outcome measure validated.	Moderate risk of bias (Moderate quality).
(Dewi & Verawati, 2022)	Pre-experimental; one-group pretest-posttest; manipulative games intervention; TGMD-2 used; no control group; no blinding; sample size small; instrument reliability described; maturation effects not addressed.	High risk of bias (Low quality).
(Valianto et al., 2023)	2x2 factorial ANOVA design; Galah Asin game x parental support; randomisation not reported; baseline described; confounding factors partially controlled through factorial design; outcome measure described; interaction effects tested.	Moderate risk of bias (Moderate quality).
(Rasyid et al., 2024)	Quasi-experimental design with matched-pair allocation to establish baseline comparability; TGMD-2 used as a validated measure of locomotor and object control skills; intervention and comparison groups clearly described; appropriate statistical analysis applied; no randomisation or blinding reported, and between-group analysis was limited.	Low-moderate risk of bias (Moderate-high quality).
(Fauzi et al., 2023)	One-group pretest-posttest design with random sample selection; FMS assessed using the validated TGMD-3 and participation measured with a structured questionnaire; intervention procedures clearly described; statistical analysis reported as independent-samples t-test despite repeated-measures design, indicating a potential reporting or analytical limitation.	Moderate risk of bias (Moderate quality).
(Hadyansah et al., 2024)	Single-group quasi-experimental pretest-posttest design; FMS assessed using the validated TGMD-2;	Moderate risk of bias (Moderate quality).

Study (Year)	Key Quality Indicators (summary of main domains)	Overall Risk of Bias / Study Quality
(Oktarifaldi, Nopembri, Yudanto, & Shahril, 2024)	intervention procedures and outcome assessment clearly described; appropriate pre-post statistical analysis conducted; absence of a control group and repeated follow-up measurements may increase the risk of bias. Cross-sectional design with clearly defined participant selection; FMS and motor coordination assessed using validated TGMD-2 and KTK instruments; standardised assessment procedures and appropriate statistical analyses applied; participant characteristics described; potential confounding factors identified but not statistically controlled.	Low risk of bias (High quality).
(Samsudin et al., 2022)	Two-group experimental; exergame vs control; 7-week intervention; TGMD-3 applied; no randomisation; baseline equivalence assumed but not reported; outcome measure validated.	Moderate risk of bias (Moderate quality).

Data Synthesis

A narrative synthesis was employed to integrate and summarise the findings of the included studies. The extracted data were organised according to the three predefined research questions, focusing on the fundamental movement skill domains assessed, the pedagogical practices implemented to support fundamental movement skill development, and the reported levels of motor competence among Indonesian elementary school children. Similarities, differences, and recurring trends across studies were identified by comparing the assessment domains, pedagogical practices, and reported levels of motor competence to provide a comprehensive overview of the current evidence.

RESULTS

A total of 16 studies published between 2021 and 2024 were included in this systematic review. As presented in Table 4, the studies examined fundamental movement skills (FMS) among Indonesian elementary school children using various assessment instruments and across multiple age groups. Object-control and locomotor domains were the most frequently assessed, each appearing in 15 and 14 studies respectively, while stability skills received substantially less attention, appearing in only one study.

Overall, the findings show that children's FMS proficiency generally falls within low to moderate levels. Several quasi-experimental studies indicate improvements following game-based, traditional game, exergame, and play-based interventions, while cross-sectional studies consistently document below-average competence across both locomotor and object-control domains. These patterns highlight variability in FMS outcomes depending on age, ecological context, assessment instruments, and pedagogical approaches.

Table 4. Results of Selected Research

Author, Year	Study design	Participants	Instrument	FMS Domains	Key Findings
(Oktarifaldi, Nopembri, Yudanto, Izwan, et	Sequential explanatory mixed-	Age 7-12 years; elementary	TGMD-3; structured observation;	Locomotor, Object-control	Most students demonstrated below average

Author, Year	Study design	Participants	Instrument	FMS Domains	Key Findings
al., 2024)	method (cross-sectional + qualitative)	school students	qualitative interviews		locomotor and object-control competence. Qualitative data revealed that limited PE time, inadequate facilities, and teacher-centered instruction were the primary barriers to FMS development.
(Mardiansyah et al., 2023)	Cross-sectional comparative (MANOVA)	Age 7-12 years; urban and rural elementary school students	KTK3+ (balance beam, jumping sideways, moving sideways, eye-hand coordination)	Stability, Locomotor, Object-control	Motor competence increased significantly with age, particularly at 10-12 years. Rural children significantly outperformed urban children on every subtest. Overall, 36% of children showed impaired motor competence.
(Wibowo et al., 2021)	Correlational cross-sectional	Age 9-11 years; elementary school students	TGMD-2; Physical Activity questionnaire	Locomotor, Object-control	A significant positive correlation was found between physical activity level and FMS competence. Students with higher PA levels demonstrated better locomotor and object-control skill scores.
(Samodra et al., 2023)	Cross-sectional comparative	Age 7-12 years; elementary school students from hill and coastal areas	TGMD-2	Locomotor, Object-control	Students from hill environments scored significantly higher on locomotor and object-control skills compared to students from coastal areas, suggesting that natural environment and habitual play

Author, Year	Study design	Participants	Instrument	FMS Domains	Key Findings
(Rizkyanto et al., 2023)	Quasi-experimental (two-group pretest-posttest)	Age 9-10 years; elementary school students	FMS assessment battery (locomotor and object-control items)	Locomotor, Object-control	context influence FMS development. Brain jogging-based instruction produced significantly greater FMS improvement compared to direct instruction. Both groups improved from pretest to posttest, but the brain jogging group showed larger effect sizes.
(Bikalawan et al., 2024)	Pre-experimental (one-group pretest-posttest)	Age 7-8 years; elementary school students	TGMD-2	Locomotor	A game-based locomotor intervention produced significant improvement in locomotor skill scores. Run, gallop, and hop showed the largest gains among the measured subskills.
(Sukoco et al., 2022)	Experimental (two-group pretest-posttest)	Age 9-11 years; elementary school students	FMS assessment instrument (locomotor and manipulative items)	Locomotor, Object-control	A 7-week traditional sport intervention significantly improved FMS scores in the intervention group compared to the control group. Traditional games provided contextually relevant movement experiences that supported locomotor and object-control development.
(Satria et al., 2024)	Pre-	Age 9-10	FMS	Object-	Game-based PE

Author, Year	Study design	Participants	Instrument	FMS Domains	Key Findings
	experimental (one-group pretest-posttest)	years; elementary school students	assessment instrument (manipulative skill items)	control	learning produced significant improvement in manipulative skill scores. Throwing, catching, and kicking subskills all showed meaningful gains from pretest to posttest. Exergame intervention over 9 weeks produced significantly greater FMS improvement than conventional PE.
(Juliantine et al., 2022)	Experimental (two-group: exergame vs control, 9 weeks)	Age 9-11 years; elementary school students	TGMD-3	Locomotor, Object-control	Both locomotor and object-control subtests improved significantly in the exergame group, with larger effect sizes compared to the control group. Manipulative games intervention produced significant improvement in object-control skill scores. Throwing and catching subskills showed the most substantial gains, while kicking improved to a lesser degree.
(Dewi & Verawati, 2022)	Pre-experimental (one-group pretest-posttest)	Age 9-10 years; elementary school students	TGMD-2	Object-control	The Galah Asin traditional game significantly improved FMS scores. A significant interaction emerged
(Valianto et al., 2023)	Experimental (2x2 factorial ANOVA)	Age 9-11 years; elementary school students	FMS assessment battery (locomotor and object-control items)	Locomotor, Object-control	

Author, Year	Study design	Participants	Instrument	FMS Domains	Key Findings
(Rasyid et al., 2024)	Quasi-experimental (two-group pretest-posttest)	Age 9-10 years	TGMD-2	Locomotor, Object-control	between game method and parental support: students with high parental support benefited more from the Galah Asin intervention than those with low parental support. Children given a play-based approach showed significantly greater improvement in basic movement skills and physical fitness than children given conventional instruction.
(Fauzi et al., 2023)	Quasi-experimental (one-group pretest-posttest)	Age 10-11 years	TGMD-3; sports participation scale	Locomotor, Object-control	Traditional games (bebentengan and boy-boyan) produced significant improvement across all seven measured FMS skills and significantly increased sports participation.
(Hadyansah et al., 2024)	Experimental (Single-Group Pretest-Posttest)	Age 9-10 years	TGMD-2	Locomotor, Object-control	The Pusaran Ular Tangga educational game improved both locomotor and object control skills, demonstrating its effectiveness for enhancing children's FMS
(Oktarifaldi, Nopembri, Yudanto, & Shahril, 2024)	Quantitative cross-sectional study	Age 7-9 years	TGMD-2	Locomotor, Object-control	Overall FMS was low, particularly object control skills, while

Author, Year	Study design	Participants	Instrument	FMS Domains	Key Findings
(Samsudin et al., 2022)	Experimental (two-group: exergame vs control, 7 weeks)	Age 9-11 years; elementary school students	TGMD-3	Locomotor, Object-control	motor coordination was average. Students with PE teachers demonstrated better FMS and motor coordination, and motor coordination was positively associated with FMS. A 7-week exergame intervention produced significant improvement in both locomotor and object-control skills compared to the control group. The exergame group showed consistently higher post-test scores across all measured FMS subskills.

Before examining the specific findings across each research question, it is useful to understand how the 16 included studies are distributed across key methodological dimensions. **Figure 2** summarises the studies by FMS domain assessed and publication year, **Figure 3** presents the distribution by assessment instrument, and **Figure 4** presents the distribution by study design. Four patterns stand out. First, publication activity increased steadily, with five studies in 2023 and six in 2024, indicating accelerating growth in Indonesian FMS research. Second, thirteen of the sixteen studies assessed multiple FMS domains simultaneously rather than isolating a single domain. Third, TGMD-2 was the most widely used assessment instrument, applied in six studies, followed by TGMD-3 in four studies, locally developed or adapted instruments in four studies, and KTK-based or mixed instruments in two studies. Fourth, quasi-experimental designs dominated the evidence base with eleven studies, compared with five cross-sectional studies. This distribution provides analytical context for interpreting the patterns reported in the sections below. The following section addresses RQ1 by identifying which FMS domains have been most frequently examined in Indonesian elementary school research and by tracing the patterns that shape this distribution.

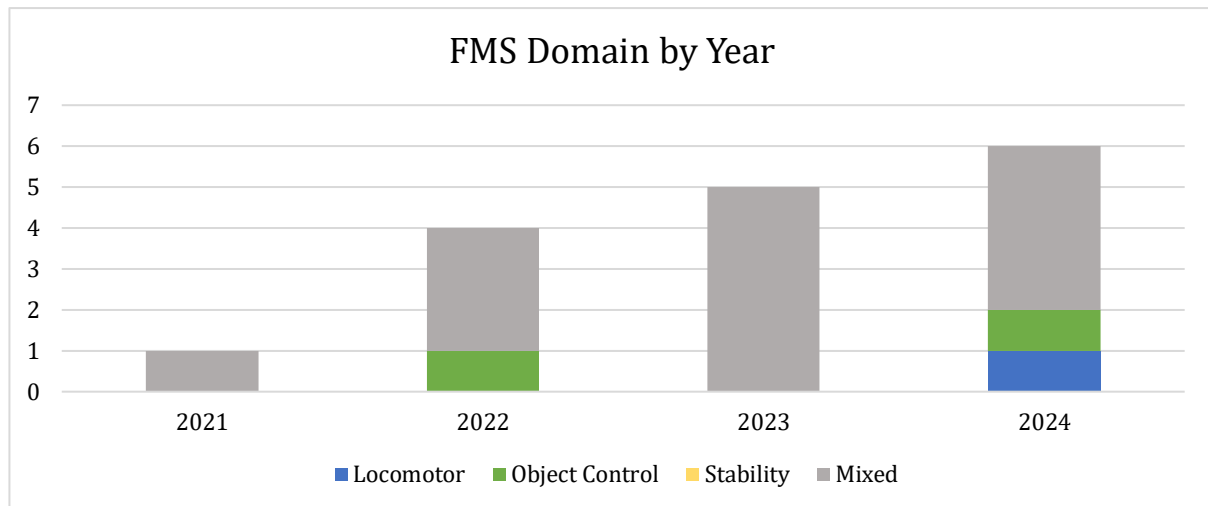


Figure 2. FMS Domain by Year

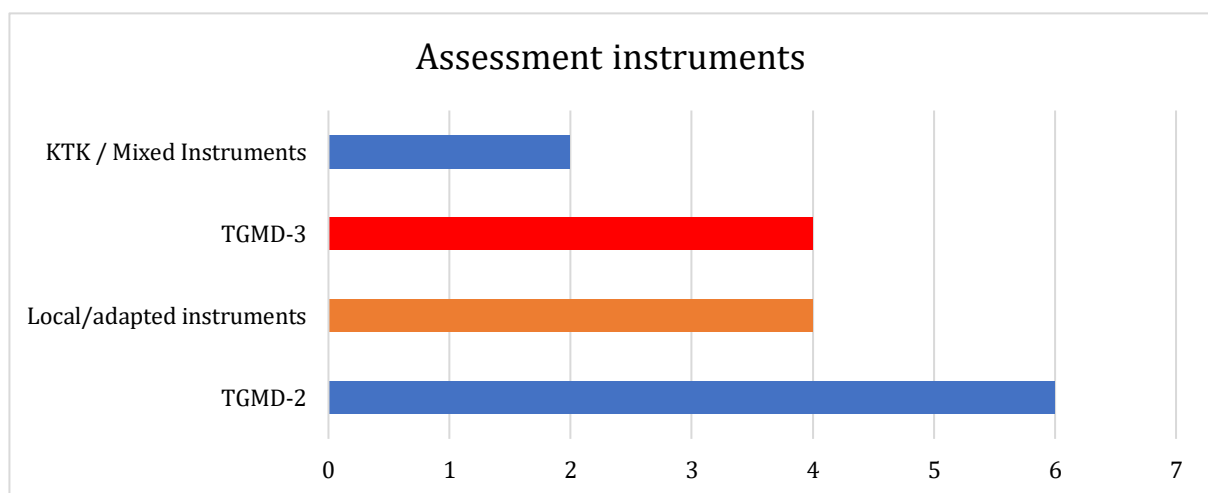


Figure 3. Assessment Instruments

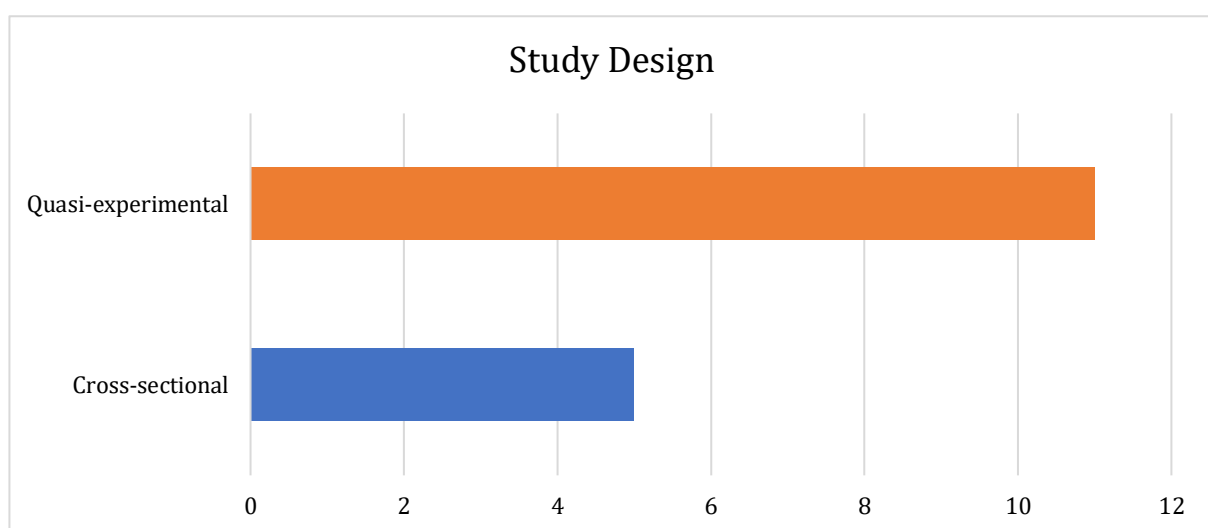


Figure 4. Study Design

DISCUSSION

Fundamental Movement Skill Domains

The synthesis of 16 empirical studies reveals a consistent pattern in the prioritisation of fundamental movement skill domains within Indonesian elementary school research. As shown in **Figure 2**, object-control skills were examined in 15 studies and locomotor skills in 14 studies, whereas stability-related skills appeared in only one study. Thirteen of the sixteen studies assessed locomotor and object-control domains together, indicating that these two domains are routinely treated as a paired unit of analysis. The distribution shows a clear dominance of dynamic and performance-oriented motor competence components. Foundational elements related to balance and postural control receive almost no independent empirical attention.

This dominance reflects the widespread use of standardised process-oriented assessment tools. Ten of the sixteen studies employed TGMD-2 or TGMD-3, two used KTK-based instruments, while the remaining four used locally developed or adapted instruments (**Figure 3**). These instruments emphasize observable movement execution, particularly locomotor and object-control tasks, and provide structured criteria for evaluating motor performance quality (Estevan et al., 2017; Wagner et al., 2017). Research designs therefore tend to align with the domains most explicitly operationalised within these tools. This alignment may also shape research priorities in ways that unintentionally marginalise stability-related competencies. When assessment instruments privilege certain skill categories, the resulting body of evidence reflects methodological convenience rather than a balanced representation of motor development.

From a developmental perspective, stability skills are not peripheral components but foundational capacities underpinning efficient movement execution. Stability, including balance regulation and postural control, supports the coordination and control required for complex locomotor and object-control performance (Lubans et al., 2012; Rudd et al., 2015). Empirical evidence demonstrates that deficits in postural control may constrain the progression of other fundamental movement skill domains (Capio et al., 2018). Only one study in this review assessed stability explicitly, and it did so through the KTK3+ balance beam subtest rather than through a dedicated stability battery (Mardiansyah et al., 2023). This near-absence raises concerns about the comprehensiveness of national motor competence profiling. If balance and postural control are embedded within broader coordination measures rather than independently assessed, subtle neuromotor limitations may remain undetected.

The underrepresentation of stability skills also warrants consideration within the context of Indonesian physical education practice. Elementary physical education curricula often prioritise active and visible motor activities such as running, jumping, and ball games (Simpson et al., 2025). These activities are pedagogically accessible and easier to evaluate in large class settings. In contrast, structured balance assessment requires more controlled measurement procedures and may be perceived as less engaging or less directly linked to sport performance outcomes (Rudd et al., 2015). Classroom realities may therefore indirectly reinforce the dominance of locomotor and object-control domains in research agendas. This alignment between curriculum practice and research focus suggests a cyclical relationship in which assessment traditions shape instructional priorities, and instructional priorities in turn influence research design.

The present findings also highlight a broader conceptual issue concerning the evaluation of motor competence in Indonesian children. By emphasising dynamic performance tasks, current research adopts a predominantly performance-based

paradigm. While performance measures are essential, contemporary motor development frameworks increasingly advocate for a more holistic approach that integrates stability, coordination, and movement adaptability. International scholarship emphasises that motor competence should not be reduced to isolated skill execution but understood as an integrated system of neuromotor control, coordination, and environmental interaction (O'Brien et al., 2016). Expanding stability assessment may therefore contribute to a more ecologically valid representation of children's motor capabilities.

Methodological heterogeneity across studies further complicates domain comparison, as illustrated in **Figure 3**. Ten studies employed TGMD-2 or TGMD-3, two used KTK-based instruments, while the remaining four relied on locally developed or adapted tools. This means that a quarter of the evidence base rests on instruments whose psychometric properties have not been established through the same validation pathways as the TGMD family. Differences in scoring systems, normative references, and operational definitions influence reported proficiency levels. The observed imbalance among domains should therefore not be interpreted solely as a developmental phenomenon but also as a reflection of methodological diversity. Strengthening instrument standardisation and validation within the Indonesian context would enhance comparability and strengthen future systematic syntheses.

Taken together, the dominance of locomotor and object-control domains in Indonesian FMS research reflects both practical and methodological influences. The near-absence of stability assessment, appearing in only one of sixteen studies and only as a subtest within a broader coordination battery, indicates a need to recalibrate research and assessment priorities. A more balanced domain representation would support comprehensive motor profiling, inform curriculum refinement, and enhance early identification of motor development challenges. Future research should incorporate explicit stability measures and consider integrating multidimensional motor competence frameworks to ensure that the evaluation of Indonesian elementary school children reflects the full spectrum of fundamental movement development.

Instructional Approaches to Supporting Fundamental Movement Skills

The synthesis of 16 empirical studies indicates that instructional approaches supporting fundamental movement skills in Indonesian elementary schools are predominantly active, student-centered, and play-oriented. Eleven of the sixteen studies tested a pedagogical intervention, while the remaining five documented existing conditions without manipulating instruction. Among the intervention studies, game-based learning was the most frequently implemented strategy, delivered through structured movement games targeting locomotor or manipulative subskills (Bikalawan et al., 2024; Dewi & Verawati, 2022; Hadyansah et al., 2024; Satria et al., 2024). Traditional Indonesian games were also incorporated as pedagogical tools, reflecting an effort to situate physical education within culturally meaningful contexts (Fauzi et al., 2023; Sukoco et al., 2022; Valianto et al., 2023).

Traditional Indonesian games and structured game-based approaches emerged as the two dominant pedagogical strategies, each supported by four studies. This parallel prominence reflects a convergence between culturally grounded and formally designed instructional models, suggesting that practitioners draw on both indigenous play traditions and structured game pedagogy to develop FMS in elementary settings. The recurrence of traditional games across multiple studies is particularly notable, as it indicates that cultural familiarity is not merely a contextual backdrop but an active pedagogical resource that Indonesian PE teachers deliberately mobilise.

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A smaller but distinct strand employed technology-mediated instruction. Two studies implemented exergame-based programmes over seven and nine weeks respectively, both reporting significant gains in locomotor and object-control competence relative to conventional physical education (Juliantine et al., 2022; Samsudin et al., 2022). One study tested brain jogging, a movement-cognitive approach combining coordination tasks with cognitive load, against direct instruction and found larger effect sizes for the former (Rizkyanto et al., 2023). Rasyid et al. (2024) compared play-based and conventional approaches among children aged 9-10 years using TGMD-2 and found that the play-based group significantly outperformed the conventional group across both locomotor and object-control domains. Taken together, this distribution indicates a shift away from technique-centered demonstration-repetition formats toward interactive and participatory models.

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Three studies now directly compare interactive approaches against conventional instruction, and all three report significantly better FMS outcomes in the interactive condition (Juliantine et al., 2022; Rasyid et al., 2024; Rizkyanto et al., 2023; Samsudin et al., 2022). This convergence across different formats, play-based, exergame, and movement-cognitive, strengthens the case that the instructional format matters less than the departure from passive, teacher-directed practice. The consistency of this finding across different age groups, instruments, and intervention durations increases its credibility within the Indonesian evidence base.

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Beyond frequency of use, the effectiveness of these approaches appears to depend on instructional design rather than format alone. Valianto et al. (2023) provide the clearest evidence on this point. Their factorial design revealed a significant interaction between the Galah Asin traditional game and parental support, with high-support students benefiting substantially more than low-support students. Cultural familiarity and game format alone did not guarantee uniform gains. This finding underscores a distinction between recreational play and instructional play. Recreational play may increase enjoyment and engagement, but instructional play requires clear learning objectives, feedback mechanisms, and progression criteria to influence motor competence meaningfully.

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Contextual evidence from the non-intervention studies helps explain why structured design matters. Oktarifaldi, Nopembri, Yudanto, Izwan, et al. (2024) identified limited physical education time, inadequate facilities, and teacher-centered instruction as primary barriers to FMS development, noting that only 39.52% of PE teachers mastered the learning materials well. Oktarifaldi, Nopembri, Yudanto and Shahril (2024) found that students in schools with PE teachers scored significantly higher on FMS than those without, providing direct empirical support for the role of qualified instruction in motor competence development. Samodra et al. (2023) found that children from hill environments outperformed coastal peers, suggesting that habitual movement opportunities outside formal instruction contribute meaningfully to competence. Wibowo et al. (2021) reported a significant positive correlation between physical activity level and FMS scores. These findings position classroom pedagogy as one component within a broader ecology of movement exposure rather than as the sole determinant of motor development.

The Indonesian findings align with international empirical evidence supporting structured and developmentally informed FMS interventions. Meta-analytic research shows that well-designed play-based interventions produce more consistent improvements in motor competence than drill-based techniques focused solely on repetition (Morgan et al., 2013; Yin et al., 2025). Comprehensive reviews further highlight

that effective FMS programs prioritize task variation, meaningful feedback, and supportive motivational climates (Logan et al., 2018; Lubans et al., 2012). Such characteristics align with contemporary learning theories that position motor development as an adaptive process shaped by interaction between the learner, task constraints, and environmental affordances (Rudd et al., 2015).

A notable limitation across the intervention studies concerns reporting quality. Only four studies specified intervention duration explicitly, ranging from seven to nine weeks (Fauzi et al., 2023; Juliantine et al., 2022; Samsudin et al., 2022; Sukoco et al., 2022). None reported implementation fidelity, teacher training, or session-level dosage in sufficient detail to permit replication. Five studies employed one-group pretest-posttest designs without a control condition, preventing maturation effects from being ruled out (Bikalawan et al., 2024; Dewi & Verawati, 2022; Fauzi et al., 2023; Hadyansah et al., 2024; Satria et al., 2024). These gaps limit the ability to identify which pedagogical components drive observed improvements. Five of eleven intervention studies employed one-group pretest-posttest designs without a control condition, meaning that nearly half the intervention evidence cannot rule out maturation or testing effects as alternative explanations for observed gains. This proportion is high enough to qualify the overall conclusion about instructional effectiveness: what is observed may reflect developmental change as much as pedagogical impact. The three studies that do include control groups and report effect sizes provide a stronger evidential foundation, and future reviews would benefit from weighting-controlled designs more heavily (Juliantine et al., 2022; Rizkyanto et al., 2023; Samsudin et al., 2022).

Taken together, the evidence indicates that FMS instruction in Indonesian elementary schools is moving toward interactive and culturally grounded pedagogies that align with international best practices. Effectiveness, however, depends on structured design, contextual adaptation, and instructional competence rather than the mere adoption of game-based formats. Strengthening teacher training, integrating evidence-based instructional frameworks, and standardising intervention reporting are essential to ensure that pedagogical innovation translates into sustained improvements in fundamental movement skills.

Fundamental Movement Skills Proficiency in Indonesian Children

The synthesis of 16 empirical studies indicates that fundamental movement skill proficiency among Indonesian elementary school children generally falls within the low to moderate range. Mardiansyah et al. (2023) reported that 36% of children in their sample showed impaired motor competence when assessed with the KTK3+ battery. Oktarifaldi, Nopembri, Yudanto and Shahril (2024) found that elementary school students scored at the average level overall (Gross Motor Quotient 78.70, percentile 30), but object-control skills fell to a low level (percentile 8), indicating that domain-specific competence can diverge substantially from overall motor quotient scores. Baseline measurements in the intervention studies were consistent with these figures, with pretest scores clustering in the low to moderate range before treatment (Bikalawan et al., 2024; Dewi & Verawati, 2022; Fauzi et al., 2023; Hadyansah et al., 2024; Juliantine et al., 2022; Samsudin et al., 2022; Satria et al., 2024). Competence in Indonesia therefore appears uneven rather than uniformly deficient, though the small number of descriptive studies limits how confidently this pattern can be generalised.

Evidence on age-related progression comes from two studies with contrasting findings. Mardiansyah et al. (2023) documented significant improvement in motor competence with increasing age among children aged 7-12 years, with the sharpest gains

occurring between 10 and 12 years. [Oktarifaldi, Nopembri, Yudanto, Izwan, et al. \(2024\)](#), however, found the opposite pattern among children aged 7-9 years: Gross Motor Quotients declined with age even as motor coordination scores improved, suggesting that different FMS components follow divergent developmental trajectories within the same age band. These contrasting findings are not merely a measurement artifact. They likely reflect genuine heterogeneity in developmental trajectories across Indonesian regions, school contexts, and PE delivery quality. A single national age trajectory cannot be assumed, and future research should stratify age analyses by region, school type, and PE teacher availability before drawing generalisations about Indonesian children's motor development.

Evidence on sex differences is similarly constrained. [Mardiansyah et al., \(2023\)](#) modeled sex explicitly alongside age and location, but the remaining fifteen studies either did not disaggregate results by sex or did not report such comparisons. The absence of sex-disaggregated reporting represents a substantive gap in the Indonesian evidence base. Broader international evidence suggests that observed disparities are shaped more strongly by participation opportunities and sociocultural influences than by biological factors alone ([Barnett, Lai, et al., 2016](#); [Gao et al., 2024](#); [Hardy et al., 2010](#)), and that gender gaps tend to narrow when equitable access to structured programmes is provided ([Morgan et al., 2013](#)). Testing these propositions in Indonesian settings requires studies that report outcomes separately for boys and girls.

Contextual and environmental variation emerged as the most consistently documented influence across the evidence base. [Mardiansyah et al. \(2023\)](#) found that rural children outperformed urban children on every KTK3+ subtest. [Samodra et al. \(2023\)](#) reported that children from hill environments scored higher than coastal peers on both locomotor and object-control domains. [Wibowo et al. \(2021\)](#) identified a significant positive correlation between physical activity level and FMS competence. [Oktarifaldi, Nopembri, Yudanto and Shahril \(2024\)](#) added a dimension absent from the previous evidence base: the presence of a qualified PE teacher independently predicted higher FMS scores, shifting part of the explanation from the physical environment to the instructional environment. Read together, these four studies suggest that both where children live and who teaches them shape FMS development more consistently than any single intervention design. This distinction between physical and instructional environments has direct policy implications. Disparities linked to terrain, habitual movement, and physical activity levels may respond best to community-level interventions that expand children's movement opportunities outside school. Disparities linked to PE teacher availability and quality, on the other hand, require targeted investment in teacher training and deployment. Treating both as a single "contextual" problem risk misaligning resources with the actual mechanisms driving competence gaps.

International literature places these findings within a broader global context. Systematic reviews and surveillance studies indicate that many children worldwide do not achieve age-appropriate FMS mastery ([Bolger et al., 2021](#); [Lorenzo-Martínez et al., 2025](#)). The low to moderate proficiency levels observed in Indonesia therefore align with global concerns rather than representing a nationally distinctive pattern. Lower motor competence has been associated with reduced physical activity engagement and increased risk of adverse health outcomes, underscoring the broader implications of uneven skill development ([Capio et al., 2015](#); [Lubans et al., 2012](#)).

The developmental model proposed by [Stodden et al. \(2008\)](#) offers a useful explanation for the observed patterns. Motor competence and physical activity operate in a reciprocal cycle: children with higher competence engage more frequently in physical activity, thereby reinforcing skill refinement, whereas those with lower competence

participate less, limiting practice and widening performance gaps (Piotrowski et al., 2025; Wu et al., 2024). The positive association between physical activity and FMS reported by Wibowo et al. (2021) is consistent with this reciprocal mechanism, though its cross-sectional design cannot establish directionality. An ecological dynamics perspective further clarifies the observed variability. Motor development emerges from interactions among individual characteristics, task demands, and environmental constraints. The rural-urban, hill-coastal, and PE-teacher availability differences documented in this review illustrate how school resources, terrain, cultural practices, and extracurricular access shape the distribution of proficiency across Indonesian contexts. This heterogeneity should be interpreted as evidence of contextual diversity rather than inherent individual limitation.

Taken together, the evidence indicates that fundamental movement skill development in Indonesia is characterised by uneven progression shaped by instructional exposure and environmental affordances. The current evidence base provides two age trajectory studies that point in opposite directions, and no included study tracked the same cohort over time. Addressing these disparities requires sustained, developmentally responsive, and contextually adaptive interventions alongside more systematic descriptive reporting. Advancing FMS competence should be positioned not only as a pedagogical objective within physical education but also as a broader educational and public health priority.

CONCLUSION

Object-control and locomotor skills dominate the Indonesian evidence base, examined in 15 and 14 studies, respectively, while stability appeared in only one study as a subtest within a broader coordination battery. Game-based, traditional game, exergame, and play-based approaches were the most common pedagogical strategies, and all 11 intervention studies reported positive effects on FMS outcomes. Overall proficiency was generally low to moderate, with environmental context and PE teacher availability more consistently documented as influencing factors than age or sex. The findings suggest that the observed domain imbalance may reflect differences in instrument selection rather than developmental patterns, highlighting instrument standardisation as a key priority.

Practically, stability and postural control should receive greater attention in elementary physical education curricula, and a nationally validated FMS battery is needed because approximately one-quarter of the evidence relies on locally developed tools with unestablished psychometric properties. However, the findings should be interpreted cautiously because the search covered Scopus alone, the review was not prospectively registered, publication bias was not assessed, and the 16 heterogeneous studies precluded quantitative pooling. Future research should expand database coverage, validate a standardised Indonesian FMS instrument, report outcomes by sex, specify intervention dosage and fidelity, and follow cohorts longitudinally across the elementary school years.

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CONFLICT OF INTEREST

The authors affirm that no conflicts of interest are associated with the publication of this manuscript.

AI DISCLOSURE STATEMENT

The authors used AI-assisted tools during manuscript preparation. Grammarly was used for language editing and clarity, while Claude supported conceptual mapping and organization of research ideas. Covidence was used to manage the article screening process. These tools did not replace the authors' judgment in study selection, data analysis, interpretation, or conclusions. The authors take full responsibility for the content, accuracy, and integrity of the manuscript.

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