



Fundamental Movement Skills Development in Children Aged 5–12: Theory, Evidence, and Pedagogical Models

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Abstract

Background. Fundamental movement skills (FMS) represent the foundational basis of children's motor development and determine their ability to successfully perform more complex sport-specific movements. FMS are strongly associated with physical activity levels, health indicators, sport proficiency, and the long-term trajectory of motor development. At the same time, substantial heterogeneity exists in definitions, pedagogical approaches, and assessment criteria, which complicates the standardization of training programs.

Objectives. To summarize contemporary theoretical, empirical, and pedagogical approaches to the development of fundamental movement skills in children aged 5–12 and to systematize evidence-based models of instruction in physical education and early sport training.

Materials and Methods. Literature searches were conducted in Scopus, Web of Science, PubMed, ERIC, and Google Scholar (2000–2025). Search terms included: “fundamental movement skills,” “motor learning,” “physical education,” “instructional model,” “manipulative skills,” “early sport training.” Additional snowball searches were carried out using the reference lists of key publications by Barnett, Ivashchenko, Khudolii, and Marchenko. Included sources comprised empirical studies, reviews, conceptual models, and programmatic reports; excluded were clinical samples and studies not reporting FMS-related data. Evidence synthesis was conducted by thematic domains.

Results. Four major research directions were identified: (1) Theoretical foundations of FMS: three categories of skills (locomotor, manipulative, stability), their coordinative basis, and contextual dependence on instructional conditions. (2) Associations between FMS, physical activity, and health: higher FMS levels are linked to increased physical activity, better fitness, and reduced obesity risk; manipulative skills are the strongest predictor of sport participation. (3) Pedagogical models of instruction: game-based interventions (GEL approach), sensory-integrative methods, structured repetition modes, and programmed instruction of complex actions demonstrate the highest effectiveness. (4) Manipulative and complex motor actions: development of throwing, catching, striking, and dribbling skills is essential for children's involvement in sports; optimized training loads (6 repetitions, 45–60 s rest) ensure maximal learning gains.

Conclusions. Development of FMS at ages 5–12 is a key component of physical education and early sport training. The most effective approaches combine game-based contexts, multisensory stimulation, and structured repetition modes. There is an urgent need to standardize FMS assessment criteria, unify testing instruments, and integrate modern digital movement-analysis tools.

Keywords: fundamental movement skills; motor competence; physical education; pedagogical models; early sport training.

Introduction

Fundamental movement skills (FMS) are defined as basic learned movement patterns that form the foundation for acquiring more complex technical and sport-specific motor actions (Barnett et al., 2016; Hulteen et al., 2018).

The core categories of FMS include locomotor, manipulative, and stability skills, the acquisition of which is closely linked to the development of motor coordination (Cools et al., 2011). In international frameworks, FMS are viewed as a key component of motor competence underpinning children's physical development (Huang & Choosakul, 2025; Yunak et al., 2022; Barnett et al., 2025).

Research findings consistently show that insufficient FMS proficiency in childhood is associated with lower levels

of physical activity, difficulties in mastering motor actions, and a higher likelihood of sedentary behavior (Lubans et al., 2010; Holfelder & Schott, 2014; Komaini et al., 2023). Barnett et al. (2009) demonstrated that FMS competence is a significant predictor of adolescents' long-term participation in physical activity and sport. Evidence from Mathisen (2016) and Fernández-Valero et al. (2021) further highlights the central role of manipulative skills and agility in determining overall motor competence in younger children.

Several key research directions underscore the relevance of studying FMS:

1. Associations between FMS, physical activity, and health (Lubans et al., 2010; Stodden et al., 2008; Samsudin et al., 2022).
2. Transfer of FMS to sport-specific skills (Barnett et al., 2016).
3. Instructional strategies for optimizing FMS learning, including Mosston's teaching styles and contemporary pedagogical models (Mosston & Ashworth, 2008; Logan et al., 2012; Lander et al., 2017).
4. Sensitivity periods of motor development (Robinson et al., 2015). Stodden et al. (2008) showed conceptually that motor competence and physical activity mutually reinforce each other throughout childhood.

The age range of 5–12 years is widely recognized as the most favorable developmental window for FMS acquisition. A systematic review by Basman (2019) identified this period as optimal for monitoring and improving FMS within physical education and early sport training. However, substantial international variability exists in defining and assessing FMS (Barnett et al., 2016; Lai et al., 2014), limiting the comparability of research findings and underscoring the need for standardized assessment tools for motor competence.

Parallel to theoretical developments, a rapidly growing body of research focuses on optimizing instructional models for FMS development. The effectiveness of game-based approaches has been confirmed in studies by Sulistiyono et al. (2021) and Samsudin et al. (2021), while sensory-integrative strategies have shown positive effects on motor learning in young children (Akbar et al., 2021). A meta-analysis by Logan et al. (2012) demonstrated that targeted pedagogical interventions lead to significant improvements in FMS. Previous research has provided a methodological foundation for optimizing repetition modes and managing training loads through the application of pattern-recognition methods, full factorial experiments, and discriminant analysis (Ivashchenko et al., 2018; Iermakov et al., 2021; Kruglov & Khudolii, 2022).

Despite the growing evidence base, several challenges remain unresolved: the absence of unified FMS assessment criteria (Basman, 2019), uneven methodological support for instruction, limited teacher readiness to apply modern approaches (Dudley et al., 2011), and insufficient integration of evidence-based findings into school and sport practice.

Therefore, there is a need to synthesize current evidence regarding: (1) the content and categories of FMS, (2) pedagogical approaches to their development, (3) the effectiveness of instructional models in early training, and (4) existing gaps in FMS assessment criteria.

The purpose of this review is to summarize modern theoretical and empirical evidence on the development of fundamental movement skills in children aged 5–12 within physical education and early sport training, to systematize findings across major thematic domains, and to outline methodological gaps requiring further investigation.

Materials and Methods

Scope and Eligibility

Population: children aged 5–12 years; preschoolers and primary school pupils.

Topics: fundamental movement skills, motor development, instructional models, sport training.

Types of publications: empirical articles, reviews, conceptual models, programmatic reports.

Languages: English and Ukrainian.

Timeframe: 2000–2025.

Inclusion criteria: studies reporting data on FMS, instructional models, or factors influencing skill development.

Exclusion criteria: clinical samples, adult populations, uncontrolled descriptive reports.

Search Strategy

The literature search was conducted in Scopus, Web of Science, PubMed, ERIC, and Google Scholar in October–November 2025. The following search terms and combinations were used: “fundamental movement skills”, “motor learning”, “physical education”, “instructional model”, “manipulative skills”, “early sport training”.

To expand the evidence base, a snowball search was additionally performed: the reference lists of key publications by Barnett et al., Ivashchenko et al., Khudolii et al., and Marchenko et al. were analyzed, allowing identification of further relevant studies on FMS development in children aged 5–12.

Search and Screening Procedure

The search process followed a structured narrative-review logic and included four stages: identification, screening, eligibility assessment, and thematic synthesis. The initial search across Scopus, Web of Science, PubMed, ERIC, and Google Scholar (October–November 2025) yielded 1,950 records. After removing duplicates ($n = 520$), titles and abstracts were screened, and 1,170 articles not related to FMS, motor development, or instructional models were excluded.

A full-text assessment was performed for 260 articles, of which 239 were excluded due to lack of FMS-specific outcome measures, insufficient methodological detail, absence of empirical data, or focus on clinical or adult populations.

A total of 21 studies met the inclusion criteria and were incorporated into the final synthesis. An additional 18 sources were identified through snowball searching of key publications (Barnett, Ivashchenko, Khudolii, Marchenko), resulting in a final dataset of 39 included references.

The relatively small number of included studies is explained by the strict inclusion criteria focusing exclusively on empirical

research directly examining FMS development in children aged 5–12, while excluding conceptual papers, descriptive reports, and studies lacking clear methodological procedures.

This multi-step screening approach ensured consistency, transparency, and reproducibility of the evidence base used in the review.

Study Selection

Screening was conducted based on titles, abstracts, and full texts. Articles lacking empirical data or not addressing FMS were excluded. Only studies meeting the predefined inclusion criteria were retained for synthesis.

Synthesis Approach

A thematic synthesis was applied, organizing the evidence into key domains that reflect the structure and logic of contemporary approaches to FMS development. Inconsistencies in FMS definitions across sources were reconciled through repeated verification of original conceptual texts (Barnett et al., 2016).

Results

Domain 1. Theoretical Approaches to FMS and Their Categorization

According to Barnett et al. (2016), fundamental movement skills (FMS) are basic, intentionally learned movement patterns that do not emerge spontaneously but are formed through pedagogical influence and serve as the foundation for sport-specific motor skills. Three primary categories are distinguished:

- Locomotor skills – running, jumping, various forms of travel.
- Manipulative skills – throwing, catching, striking, dribbling.
- Stability skills – balance and postural control.

FMS are closely linked to motor coordination, which is a key component of overall motor competence (Mathisen, 2016).

In modern literature, FMS are consistently described as intentionally formed motor actions that create the basis for mastering more complex physical exercises and sport techniques. Barnett and colleagues emphasize that FMS are not natural expressions of spontaneous activity but products of structured learning within organized instructional environments (Barnett et al., 2016). Consequently, FMS are treated as a central element of motor competence and a major indicator of children's motor development.

Classical theoretical models of FMS converge on a three-component classification: locomotor, manipulative (object-control), and stability skills. Locomotor skills involve spatial movement of the body (running, jumping, traveling sideways), manipulative skills involve controlling external objects (throwing, catching, striking), and stability skills reflect the ability to maintain postural control and balance (Barnett et al., 2016; Lubans et al., 2010; Cools et al., 2011). This structure enables identification of typical movement patterns that serve as building blocks for more specialized motor actions.

A critical aspect of theoretical approaches is the link between FMS and motor coordination. Research (Mathisen, 2016; Cools et al., 2011; Marchenko, 2025; Marchenko & Fedotov, 2024) demonstrates that children's motor competence is determined not only by individual test results but by integrated development of agility, balance, and coordination. For example, according to Movement ABC assessments, a significant proportion of six-year-old children fall into "borderline" or "motor difficulty" categories, indicating the need for targeted intervention programs (Mathisen, 2016). Thus, coordination is not a background factor but a structural determinant of FMS.

Another theoretical dimension concerns the broader context of FMS development – the family environment, instructional conditions, cultural norms, and organizational features of physical education lessons. Cools et al. (2011) showed that preschool children's FMS levels correlate with family-related factors such as parents' physical activity, access to play spaces, and support for active behavior. Similar findings were reported by Hardy et al. (2010, 2012) and Fowweather et al. (2015): insufficient FMS development is a systemic issue rather than an isolated individual characteristic. This broadens the theoretical perspective, situating FMS not merely as a child's attribute but also as an indicator of the quality of the environment in which the child learns and grows.

Work by Barnett et al. (2009, 2013, 2016) and Hulteen et al. (2018) integrates FMS into life-course models of motor competence. In these frameworks, FMS serve as a crucial intermediary between early physical activity, physical fitness, motivation, and long-term engagement in sport. Hulteen et al. (2018) propose a "Foundational Movement Skills" model in which FMS serve as prerequisites for developing more complex motor patterns during school years and later specialization in sport. Thus, FMS have predictive value: their level in early childhood influences future pathways of physical activity and participation.

However, a systematic review by Basman (2019) identified a major methodological challenge: the absence of unified and widely accepted FMS assessment criteria for children aged 5–12. Studies employ different tools – full standardized tests (e.g., TGMD), modified subtests, or isolated skill assessments – which hinders direct comparison of results and complicates interpretation of intervention effectiveness. This highlights the need for methodological unification of FMS concepts and assessment criteria.

In summary, theoretical approaches to FMS encompass:

1. Structural definition: classification into locomotor, manipulative, and stability skills.
2. Coordinative foundation: FMS as manifestations of integrated motor competence.
3. Contextual dependence: influence of family, school, cultural, and environmental factors.
4. Life-course trajectory: FMS as a basis for physical activity and sport participation across the lifespan.
5. Methodological challenges: heterogeneity of definitions, assessment instruments, and criteria.

This theoretical framework provides the foundation for analyzing empirical evidence on the relationships among FMS, physical activity, health, and instructional models, which are explored in the subsequent domains (table 1, 2).

Table 1. Theoretical Approaches to FMS and Their Categorization

Theoretical Aspect	Key Content / Approach	Authors	Significance for Understanding FMS
Basic Definition of FMS	FMS are learned—not spontaneous—movement actions; formed through intentional instruction and serve as the foundation for complex sports skills.	Barnett et al. (2009, 2016); Hulteen et al. (2018)	Emphasizes that FMS are targets of pedagogical intervention and justify their central role in physical education curricula.
Three-Component Classification	FMS are divided into locomotor, manipulative (object-control), and stability skills, each with typical movement patterns and assessment criteria.	Barnett et al. (2016); Lubans et al. (2010); Cools et al. (2011)	Supports structured instructional planning, skill-group-specific assessment, and program design.
FMS as Core of Motor Competence	FMS represent the central component of motor competence, including coordination, agility, balance, and object control.	Stodden et al. (2008); Cools et al. (2011); Mathisen (2016)	Explains why FMS predict physical activity and sport proficiency; links FMS to broader developmental models.
Coordinative Basis of FMS	FMS depend on coordination, agility, balance, synchronization; coordination is a structural determinant.	Mathisen (2016); Cools et al. (2011); Hardy et al. (2012)	Justifies integration of coordination training and testing in FMS programs.
Contextual Approach	FMS levels depend on family environment, cultural factors, PE organization, access to play spaces.	Cools et al. (2011); Hardy et al. (2010, 2012); Foweather et al. (2015)	Highlights the environmental nature of FMS development and the importance of supportive contexts.
Life-Course Perspective	FMS are a platform for lifelong participation in physical activity and sport.	Barnett et al. (2009, 2016); Hulteen et al. (2018)	Demonstrates predictive value of early FMS proficiency.
Methodological Issues	Lack of unified criteria, different tools and scales (TGMD, MABC), varied interpretations across countries.	Basman (2019); Lai et al. (2014); Lubans et al. (2010)	Explains challenges in comparing findings and stresses the need for standardization.

Table 2. Categories of FMS and Their Characteristics

FMS Category	Examples of Movements	Function in Motor Development	Typical Tests / Assessment Tools
Locomotor Skills	Running, jumping, hopping, galloping, sideways movement, changes of direction	Enable whole-body movement through space; form the basis for endurance and speed development	TGMD subtests (run, hop, gallop); standing long jump / vertical jump; speed and agility tests
Manipulative Skills (Object-Control Skills)	Throwing, catching, striking, dribbling	Form the foundation for invasion team sports, precision tasks, and interaction with objects	TGMD (throw, catch, strike, dribble); sport-specific ball-handling tests; team-based FMS assessments
Stability Skills (Balance)	Static and dynamic balance positions, posture control, various stances	Provide postural control and stability required for complex movement actions	MABC balance tasks; static/dynamic balance tests; instructional observations during PE lessons

Domain 2. Associations Between FMS, Physical Activity, and Health

In leading theoretical models of motor development, fundamental movement skills (FMS) are considered a critical determinant of children’s physical activity levels and their ability to participate in health-enhancing and sport-related behaviors. The conceptual model proposed by Stodden et al. (2008) shows that motor competence, physical activity, physical fitness, and obesity risk are linked through cyclical and mutually reinforcing mechanisms. Children with low FMS proficiency are less likely to engage in dynamic forms of activity, which in turn reinforces deficits in competence and leads to a negative trajectory of motor development.

High-quality meta-analyses confirm that FMS are a prerequisite for active daily behavior rather than a mere

outcome of physical activity. Lubans et al. (2010), in a systematic review, demonstrated that children with higher scores in locomotor and manipulative skill tests exhibit greater levels of moderate-to-vigorous physical activity. Holfelder and Schott (2014) further noted direct associations between FMS and health indicators, including cardiometabolic markers and risk profiles related to sedentary behavior. Well-developed motor competence facilitates regular engagement in both structured and unstructured physical activity.

Manipulative skills – one of the core categories of FMS – play an especially important role in children’s participation in sports and in the development of movement confidence. Mathisen (2016) found that coordination abilities, including throwing and catching accuracy, are among the strongest predictors of general motor competence in children

Table 3. Associations Between FMS, Physical Activity, Physical Fitness, and Health

Aspect of Association	Key Content / Explanation	Authors	Significance for Understanding FMS
FMS and Physical Activity Levels	Higher FMS levels are associated with greater participation in moderate-to-vigorous physical activity (MVPA). Children with low motor competence participate less in active games and sport.	Stodden et al. (2008); Lubans et al. (2010); Barnett et al. (2009)	Demonstrates that FMS are a prerequisite – not merely a result – of physical activity; developing FMS is essential for increasing daily activity.
FMS and the “Negative Spiral” of Sedentary Behavior	Stodden model: low FMS → low activity → reduced physical fitness → further decline in competence → increased body mass.	Stodden et al. (2008); Hardy et al. (2010, 2012)	Explains how persistent sedentary patterns develop; highlights the need for early interventions to enhance FMS.
FMS and Physical Fitness	Higher FMS proficiency correlates with better aerobic fitness, muscular endurance, agility, and coordination. FMS serve as a threshold for effective fitness development.	Hardy et al. (2012); Lubans et al. (2010); Robinson et al. (2015)	Shows that without basic FMS, fitness-training programs are less effective; positions FMS as the foundation of physical fitness.
Manipulative Skills and Sport Participation	Manipulative skills (throwing, catching, striking, dribbling) are strongly linked to involvement in team sports and movement confidence.	Mathisen (2016); Fernández-Valero et al. (2021); Hardy et al. (2012)	Explains why deficits in manipulative skills often act as barriers to sport participation; justifies prioritizing their development at ages 5–12.
FMS and Health Profile (Obesity, Metabolic Risks)	Low FMS proficiency is associated with higher body mass, obesity risk, and unfavorable cardiometabolic indicators.	Stodden et al. (2008); Holfelder & Schott (2014); Hardy et al. (2010)	Highlights FMS as a health marker and a potential strategy for obesity prevention.
FMS, Self-Perception, and Motivation	Motor competence influences perceived physical competence, motivation for physical activity, and sport confidence.	Barnett et al. (2016); Robinson et al. (2015); Morgan et al. (2013)	Demonstrates that FMS development should be accompanied by motivational support to prevent avoidance of physical activity.
FMS as an Integrative Indicator of Development	FMS reflect the combined influence of biological, pedagogical, and social factors and represent a “snapshot” of a child’s motor, functional, and psychosocial status.	Lubans et al. (2010); Stodden et al. (2008); Hulteen et al. (2018)	Supports the use of FMS for monitoring developmental progress and evaluating instructional and training programs.

Table 4. FMS and Key Health and Behavioral Outcomes

FMS Component	Typical Outcome at High Level	Typical Outcome at Low Level
Locomotor Skills	Regular participation in running, active games, physically engaging recess activities; better endurance and aerobic capacity	Avoidance of vigorous play; rapid fatigue; low tolerance for dynamic activities
Manipulative Skills (Object-Control Skills)	Confidence in ball games; successful participation in team sports; higher movement self-efficacy	Avoidance of games involving balls; difficulty joining team play; reduced opportunities to practice skills
Stability Skills (Balance/Postural Control)	Good postural stability; readiness for complex actions (e.g., gymnastics, acrobatics, martial arts); safer movement execution	Poor balance; difficulty performing complex motor tasks; higher injury risk; hesitancy in dynamic actions
Overall Motor Competence	Higher levels of MVPA; greater interest in physical activity; positive long-term developmental trajectory	Sedentary tendencies; reduced activity; reinforcement of a negative developmental spiral
Motor Coordination	Effective learning of new skills; better synchronization and timing of movements	Difficulty mastering coordinated actions; slower learning pace
Self-Perception and Motivation	High perceived motor competence; strong motivation for physical activity; willingness to engage in sport	Low confidence; fear of failure; avoidance of PE lessons and sport activities
Health Profile	Favorable body composition; lower obesity risk; better cardiometabolic indicators	Higher body mass; increased obesity risk; poorer metabolic profile; long-term health vulnerabilities

aged 6–8. Fernández-Valero et al. (2021) reported that children who score higher on ball-handling tasks exhibit significantly greater daily moderate-to-vigorous physical activity (MVPA). Children with poor manipulative skill development tend to participate less in active games, limiting opportunities for natural motor practice.

FMS are also directly associated with physical fitness. Hardy et al. (2012) demonstrated that FMS proficiency in children aged 8–10 correlates with aerobic fitness, muscular endurance, and coordination. A minimal level of motor competence acts as a “threshold condition” for effective development of fitness components. Children with low coordination often demonstrate lower levels of physical fitness, which reduces sport participation and limits their developmental potential.

Particular attention has been given to the relationship among FMS, body mass, and obesity risk. Stodden et al. (2008) proposed that low FMS proficiency combined with low activity levels contributes to a “negative spiral,” where increased body mass further impairs motor competence, which in turn reduces activity even more. Empirical findings from Hardy et al. (2010) support this model: children with lower FMS scores are more likely to have overweight or obesity, while their physical activity levels remain consistently below age norms. Motor inadequacy in childhood may serve as a long-term health risk factor.

The psychosocial dimension of FMS has also gained growing attention. Barnett et al. (2016) noted that motor competence influences movement-related self-esteem, motivation for physical activity, and perceived sport competence. Longitudinal studies show that children with higher perceived motor confidence are more likely to join sports programs and maintain high levels of activity throughout childhood.

Overall, scientific evidence indicates that FMS are not merely a set of isolated movement abilities but an important integrative characteristic shaping children’s physical activity, fitness, health outcomes, and motivation to engage in physical and sport activities. Therefore, the development of FMS in children aged 5–12 is a fundamental task of physical education and early sport training (table 3, 4).

Domain 3. Pedagogical Models, Strategies, and Game-Based Interventions (EN)

Current research increasingly focuses not only on describing the levels of FMS development but also on identifying optimal pedagogical strategies for enhancing these skills within physical education and early sport training. The aim of most intervention programs is to create conditions in which children receive a sufficient volume of purposeful motor practice in a motivationally appealing format, ensuring both skill acquisition and sustained engagement in physical activity (Logan et al., 2012; Morgan et al., 2013). Effective pedagogical models combine structured instruction with game-based dynamics and controlled exercise repetition modes.

One of the most compelling directions involves game-based learning models, where the development of FMS occurs within the context of specially organized games. A study by Sulistiyono et al. (2021) demonstrated the effectiveness of the Game Experience Learning (GEL) model in training

young football players: its four stages – game experience, reflection, conceptualization, and implementation – ensure not only improvements in technical-tactical skills but also the development of team interaction, social competencies, and responsible on-field behavior. The coach deliberately uses game situations as “material” for cultivating desired action patterns, combining physical load with moral-volitional and communicative influences.

Similar results have been reported in volleyball. Samsudin et al. (2021) developed a set of instructional models for teaching basic volleyball movements in primary school children, where the game-based approach served as the primary means of increasing interest, engagement, and the effectiveness of technical skill acquisition. The authors emphasize the importance of safety, discipline, and appropriately dosed task difficulty, enabling children to perform movements freely while avoiding injury risks. Testing results confirmed that game-based models significantly improve mastery of fundamental volleyball techniques compared to traditional approaches.

Another important direction is the integration of FMS development with sensory integration, particularly under remote or blended learning conditions. Akbar et al. (2021) show that early childhood motor development should be implemented through a game-based approach that purposefully stimulates auditory, visual, vestibular, tactile, and proprioceptive systems. The authors highlight that instructional videos and home-based activities can be effective if they include running, jumping, walking, throwing, balancing tasks and simultaneously activate multiple sensory channels. This supports the rationale for using multisensory stimulation as a means of optimizing motor development under conditions of limited mobility.

In addition to game-based and sensory-integrative models, considerable attention has been paid to the structuring of repetition modes. The FMS evidence base includes studies employing full factorial experiments and discriminant analysis to determine optimal numbers of repetitions, rest intervals, and exercise sequences for teaching target throwing with a small ball and complex coordination gymnastics elements (Ivashchenko et al., 2018; Iermakov et al., 2021). For example, among eight-year-old boys, a mode of six repetitions with a 60-second rest interval produced the highest overall learning gains, and classification analysis showed high accuracy in assigning pupils to appropriate loading-parameter groups.

Similar approaches are applied in the development of complex coordination movements—acrobatics and kicking techniques in martial arts. Research by Rukavytsia et al. (2022) and Marchenko et al. (2022, 2023, 2024) revealed that programmed instruction combined with pattern-recognition models enables a step-by-step construction of the learning process, taking into account individual differences among pupils. These approaches focus on managing not only the quantitative load parameters but also the structure of the motor task, which is particularly important for forming fine-grained coordination mechanisms.

A crucial component of pedagogical strategies is the professional preparation of teachers and coaches, as they implement instructional models in practice. In their systematic review, Dudley et al. (2011) emphasize that the most effective school physical education programs

Table 5. Pedagogical Strategies, Instructional Models, and Game-Based Interventions

Type of Pedagogical Strategy / Model	Key Characteristic / Didactic Logic	Key Authors and Studies	Main Effects and Conclusions
Game-Based Learning Models (GEL)	Development of FMS within specially organized game situations; structure “experience – reflection – conceptualization – implementation”; integration of technique, tactics, and social interaction.	Sulistiyono et al. (2021); Samsudin et al. (2021)	Increased technical–tactical skills, team interaction, motivation; improved manipulative skills and coordination in game-based sports.
Game Models for Primary School (small-sided formats 1×1, 2×2)	Creation of numerous repetitions of motor actions in simulated game episodes; high frequency of ball touches and decision-making.	Samsudin et al. (2021); Morgan et al. (2013)	Improved execution of basic elements (passing, striking, catching); active involvement of all children; reduced passive time during lessons/training.
Sensory-Integrative Approaches	Use of tasks that simultaneously stimulate several sensory systems (visual, auditory, vestibular, tactile, proprioceptive) in a game format; especially relevant for remote/blended learning.	Akbar et al. (2021)	Accelerated acquisition of basic FMS (running, jumping, throwing, balance); better adaptation to varied task conditions; increased interest in home-based motor tasks.
Structured Repetition Modes (load optimization)	Determination of optimal repetitions, duration, and rest intervals based on full factorial experiments and discriminant analysis; programmed load management.	Ivashchenko et al. (2018); Iermakov et al. (2021)	Identification of optimal modes (e.g., 6 repetitions with 60 s rest) for maximal learning; opportunities for individualized instruction; higher lesson/training efficiency.
Programmed Instruction of Complex Coordination Movements (acrobatics, martial-arts kicks)	Step-by-step construction of the motor action; use of pattern-recognition models; integration of analytical and holistic teaching methods.	Rukavytsia et al. (2022); Marchenko et al. (2022, 2023, 2024)	Accelerated acquisition of complex motor actions; reduction of technical errors; ability to predict individual learning trajectories.
Combined Models (game-based + structured repetition modes)	Integration of a game context with precisely dosed load parameters; alternation of game tasks and programmed exercise series.	Logan et al. (2012); Ivashchenko et al. (2018)	Concurrent high motivation and controlled skill gains; improved fatigue tolerance; better movement automatization.
Teacher and Coach Professional Development	Targeted professional training programs focused on FMS development; mastery of evidence-based instructional models.	Dudley et al. (2011); Lander et al. (2017)	PE and sport programs with an FMS component are effective only when educators are competent in the methodology; improved lesson and training quality.
Whole-School Programs (whole-school approach)	Integration of FMS into curricula, recess activities, extracurricular events; involvement of administration, parents, and coaches; promotion of an active school environment.	Morgan et al. (2013); Hardy et al. (2012)	Sustained improvement in FMS and physical activity; higher participation in sport; long-term community-level benefits.
Mosston & Ashworth’s Spectrum of Teaching Styles	A universal model conceptualizing instruction as a continuum of pedagogical decisions; spans from reproductive styles (A–E: precision and control) to productive styles (F–K: inquiry, variability, learner autonomy). Implements a non-versus paradigm where styles complement each other.	Mosston & Ashworth (2008)	Provides a methodological framework for configuring FMS interventions – from controlled repetition modes to game-based and inquiry formats; aligns lesson goals, feedback type, and learner autonomy in FMS development.

combine: a clearly articulated curriculum, elements of direct instruction, whole-school strategies for supporting physical activity, and ongoing teacher professional development. Lander et al. (2017) further note that teacher training specifically focused on FMS development is essential for the successful implementation of intervention programs.

Within pedagogical models, an important theoretical foundation is the Mosston & Ashworth Spectrum of Teaching Styles, which conceptualizes the teaching of motor actions as a chain of pedagogical decisions involving a gradual shift from reproductive styles (A–E) – ensuring precision, control,

and standardized technique – to productive styles (F–K), which promote exploration, variability, and autonomous movement problem-solving (Mosston & Ashworth, 2008). This logic of structured transfer of decision-making from teacher to pupil enables FMS development across diverse instructional formats – from guided instruction to game-based and inquiry-based interventions – ensuring coherence between lesson objectives, types of feedback, and the child’s level of autonomy.

Thus, contemporary pedagogical strategies for developing FMS can be viewed as multicomponent models

Table 6. Strategy – What It Does – Purpose

Strategy	What It Does (Specific Actions)	Purpose / Main Effect
Spectrum of Teaching Styles (Mosston & Ashworth)	Organizes instruction as a continuum of styles ranging from full teacher control to high learner autonomy; defines a sequence of pedagogical decisions (who decides what and when).	Provides a universal framework for selecting FMS teaching styles for specific goals: from technical precision to creative, game-based, or autonomous performance of motor tasks.
Game-Based Learning (GEL)	Transfers FMS into real or simulated game situations.	Increases interest and engagement while simultaneously developing technique and tactics.
Sensory Integration	Combines FMS with multichannel sensory stimuli.	Improves movement perception and adaptation to different task conditions.
Structured Repetition Modes	Precisely regulates the number of repetitions and rest intervals.	Maximizes learning gains and lesson efficiency.
Programmed Instruction	Breaks down a complex motor action into stages and uses structured models.	Enables learning complex movements without chaotic trial-and-error attempts.
Teacher Professional Development	Trains teachers/coaches to work with FMS instructional models.	Ensures high-quality implementation of programs in practice.

that include game-based methods, sensory-integrative approaches, optimized repetition modes, and specialized teacher preparation. Their common features are reliance on quantitatively and qualitatively justified loading schemes, a high degree of instructional structure, and the preservation of a playful, emotionally engaging character of activities – elements that are critically important for children aged 5–12.

Domain 4. Development of Manipulative and Complex Motor Skills (EN)

Manipulative skills (ball control, catching, throwing, striking, dribbling) are recognized as one of the most critical components of fundamental movement skills, as they enable the transition from basic motor experience to participation in sport-specific activity. Research by Barnett et al. (2009, 2016) and Mathisen (2016) has demonstrated that the level of manipulative skill development is a powerful predictor of overall motor competence and sport success. Children who achieve high scores in object-control tests display greater involvement in active games, higher confidence in movement-related tasks, and elevated levels of physical activity.

Studies by Fernández-Valero et al. (2021) emphasize that ball-handling abilities—particularly throwing and catching—have the strongest association with overall physical activity levels among primary school children. Similarly, Hardy et al. (2012) found that children with low manipulative performance demonstrate lower endurance and reduced motivation to engage in sports activities. The FMS literature further notes that insufficient development of manipulative skills limits opportunities for natural motor practice in play settings, creating a secondary “experience deficit” and slowing the development of motor competence.

Within pedagogical strategies, instructional models aimed specifically at developing manipulative skills in sport-game formats have become increasingly widespread. Evidence-based interventions show that children acquire object control most effectively through specially designed game tasks that integrate technical execution, social interaction, and competitive elements. In volleyball (Samsudin et al., 2021) and football (Sulistiyo et al., 2021), game-based instructional models grounded in GEL

principles have produced substantial improvements in ball-handling skills, movement accuracy, and team coordination. The FMS framework also notes that game-based techniques provide a natural learning environment for developing manipulative actions in younger children.

The formation of manipulative actions requires not only an enriched game environment but also clearly defined load parameters that determine repetition mode, task duration, and rest intervals. Ukrainian studies (Ivashchenko et al., 2018; Iermakov et al., 2021) on teaching target throwing with a small ball show that optimizing the number of repetitions and gradually regulating task complexity are essential for learning gains. Specifically, it has been established that a mode of six repetitions with regulated rest intervals results in the highest acquisition rates among children aged 7–10.

Research on the mechanisms underlying the development of more complex manipulative and coordination actions (martial-arts kicking, acrobatic skills, technical elements in game sports) relies on modelling the structure of the motor action. Studies by Rukavytsia et al. (2022) and Marchenko et al. (2022, 2023, 2024) show that the use of pattern-recognition methods and programmed instruction enables the step-by-step formation of complex motor elements while accounting for individual learner characteristics. Factor modelling has allowed researchers to identify optimal repetition parameters, instructional sequences, and load levels necessary for developing accuracy, rhythm, and coordinated movement patterns.

Finally, contemporary literature highlights the importance of multisensory integration in the development of manipulative skills. Akbar et al. (2021) demonstrated that combining tactile, vestibular, visual, and auditory stimuli substantially enhances the acquisition of basic movements (walking, running, jumping, throwing), particularly under remote or blended learning conditions.

In summary, manipulative skills are not merely a subcategory of FMS but a key mechanism enabling the transition from general motor development to sport participation. They allow children to engage in active games and team sports, form the foundation of technical preparedness, and determine subsequent motor development pathways. Multiple studies confirm that game-based models, optimized repetition modes, sensory integration, and step-

Table 7. Manipulative Skills: Effective Pedagogical Strategies and Evidence Base

Category of Manipulative Skills	Effective Pedagogical Strategies	Key Studies (High Level of Evidence)	Rationale / Main Conclusions
Throwing and Catching	- Game-based models (GEL) - Sensory-integrative approaches - Targeted exercises with regulated repetitions	Sulistiyono et al., 2021; Mathisen, 2016; Fernández-Valero et al., 2021	Game situations enhance accuracy and variability; sensory stimuli improve trajectory perception; optimal repetition modes increase learning efficiency.
Ball Striking (hands/feet)	- Game-based learning - Programmed instruction (step-by-step movement construction) - Video analysis and technique correction	Samsudin et al., 2021; Suprun et al., 2021; Medko & Khudolii, 2021	Game format enhances motivation; stepwise modelling develops technical stability; video analysis provides precise feedback.
Dribbling and Object Control	- Combined sensorimotor exercises - Variable training (changes in speed, amplitude, angle of attack) - Individualized load parameters	Akbar et al., 2021; Morgan et al., 2013; Hardy et al., 2012	Variability broadens motor experience; sensory integration improves spatial awareness and control; individualized modes ensure stable skill acquisition.
Precision Technical Manipulations (volleyball, basketball, baseball)	- Specialized game tasks - Small-sided games 1×1, 2×2 - Programmed error correction	Samsudin et al., 2021; Lander et al., 2017	Team game actions integrate technique and tactics; small-sided games increase ball-contact frequency; programmed drills minimize typical errors.
Coordination-Complex Manipulations (acrobatics, martial arts)	- Step-by-step action construction - Factor modelling of repetition modes - Pattern-recognition methods	Rukavytsia et al., 2022; Marchenko et al., 2022, 2023, 2024; Iermakov et al., 2021; Ivashchenko et al., 2018	Modelling identifies optimal load parameters; pattern recognition enables individualized formation of complex motor actions.
Integrated Manipulative–Locomotor Actions (active games)	- Mixed-skills training - Game tasks with role switching - Combination of manipulations and locomotion	Logan et al., 2012; Barnett et al., 2009; Hulteen et al., 2018	Combined movements create richer motor schemas; role switching enhances cognitive and social components; hybrid actions increase overall motor competence.

Table 8. Optimal Repetition Modes for Manipulative Skills (EN)

Age	Optimal Repetition Mode	Rest Interval	Type of Motor Task	Source
7–8 years	6 repetitions	45–60 s	Target throwing with a small ball	Ivashchenko et al., 2018
8–9 years	5–6 repetitions	60 s	Martial-arts strikes (strike formation stage)	Medko & Khudolii, 2021
9–10 years	6–8 repetitions	60–90 s	Technical volleyball elements	Samsudin et al., 2021

by-step motor-action modelling are among the most effective approaches to developing manipulative skills in children aged 5–12 (table 7, 8).

Domain 5. Key Gaps and Methodological Challenges (EN)

The assessment of fundamental movement skills is one of the most problematic and, at the same time, most essential aspects of FMS research. In a systematic review, Basman (2019) emphasized that the field currently lacks unified measurement standards, and researchers employ a wide variety of test batteries, making cross-study comparisons extremely difficult. The author notes that differences in theoretical approaches to defining FMS (locomotor, manipulative, stability skills) and the diversity of assessment methods create significant methodological barriers to developing coherent instructional programs.

The most commonly used assessment instruments are the Test of Gross Motor Development (TGMD-2 / TGMD-3), the Movement Assessment Battery for Children (MABC-2), and the Bruininks–Oseretsky Test of Motor Proficiency (BOT-2). Cools et al. (2011) highlight that the choice of test significantly shapes the interpretation of FMS levels, as each battery targets different skill components and uses different scoring approaches (criterion-referenced in TGMD vs. norm-referenced in MABC). The FMS evidence file also notes that MABC-2 often identifies a higher prevalence of motor impairments, whereas TGMD-2 focuses primarily on the qualitative characteristics of movement and specific performance components. Such inconsistencies in test content create a risk of misclassifying children's motor competence.

A critical issue is the alignment between test outcomes and children's real-life motor abilities. Mathisen (2016)

demonstrated that pupils with low MABC-2 scores frequently exhibit problems with agility, balance, and object control in everyday movement situations. Hardy et al. (2012) confirm that low manipulative skills (catching, throwing) show the strongest association with general difficulties in physical development.

FMS assessment is closely linked to the challenge of identifying sensitive periods of motor development. According to Stodden et al. (2008), inadequate FMS levels in early childhood may lead to a “negative spiral”: low skill level → low physical activity → reduced physical fitness → even lower motor competence. For this reason, many authors (Barnett et al., 2016; Logan et al., 2012) argue that early FMS screening is essential for identifying children at risk of motor insufficiency.

Moreover, digital and video-analytic methods of assessing FMS have gained increasing attention, enabling precise kinematic characterization of movement. The use of pattern-recognition and clustering algorithms (Ivashchenko et al., 2018; Iermakov et al., 2021) makes it possible not only to evaluate skill performance but also to predict optimal load parameters

for each child. This aligns with current trends toward personalized instruction in physical education and sport.

However, despite technological advances, a major problem remains the absence of universally accepted criteria for determining FMS levels. Lai et al. (2014) and Hardy et al. (2012) show that different researchers apply different scales and thresholds to define “high” or “low” skill levels. This complicates meta-analyses and cross-study comparisons of interventions. The FMS evidence file also indicates that many school programs lack clear benchmarks for FMS assessment, limiting the ability to systematically track pupils’ progress.

In summary, FMS assessment is a central component of both pedagogical and research practice. Testing not only reveals the current level of skill development but also identifies risk factors, predicts motor development trajectories, enables individualized instruction, and provides evidence-based monitoring of program effectiveness. However, to fully leverage the potential of FMS in educational settings, standardization of criteria, unification of test batteries, and wider implementation of digital assessment tools are essential (table 9, 10).

Table 9. Assessment, Testing, and Measurement Criteria for FMS

Aspect of FMS Assessment	Key Concept / Approach	Authors Represented in the Literature	Importance for Theory and Practice
Lack of unified assessment standards	Wide variety of tests and author-developed tools; absence of agreed-upon FMS level criteria for ages 5–12.	Basman (2019); Lai et al. (2014)	Complicates comparison of results; limits standardization of instructional programs and evaluation of their effectiveness.
TGMD (Test of Gross Motor Development)	Criterion-referenced assessment of locomotor and manipulative skills (movement patterns, key execution phases).	Ulrich (TGMD-2, TGMD-3); Lubans et al. (2010)	Enables detailed analysis of FMS technique; well-suited for pedagogical interventions and program evaluation.
MABC-2 (Movement Assessment Battery for Children)	Norm-referenced test; focuses on identifying motor impairments and “at-risk” groups; includes tasks for manipulation, balance, and agility.	Cools et al. (2011); Mathisen (2016)	Used for screening motor difficulties; identifies children needing special interventions.
BOT-2 and other comprehensive batteries	Extensive set of tests assessing fine and gross motor skills, coordination, strength, and agility; mainly used in clinical and research settings.	Bruininks & Bruininks; Holfelder & Schott (2014)	Provides a detailed motor development profile; useful for deep diagnostics but less practical for mass school testing.
Gap between test outcomes and real-life skills	Test results do not always reflect children’s behavior in everyday motor situations; pedagogical observation is crucial.	Mathisen (2016); Hardy et al. (2012)	Highlights the need to complement formal testing with qualitative movement analysis in lessons and training sessions.
Early screening and sensitive periods	Assessing FMS at ages 5–9 allows identification of children at risk of motor insufficiency and prevents the development of the “negative spiral.”	Stodden et al. (2008); Barnett et al. (2016); Logan et al. (2012)	Supports systematic early testing; justifies incorporating FMS screening into school PE programs.
Digital and video-analytic methods	Use of video, kinematic analysis, and pattern-recognition algorithms to assess complex movements.	Ivashchenko et al. (2018); Iermakov et al. (2021)	Enables detailed analysis of technique, personalized instruction, and prediction of skill acquisition success.
Problem of defining “high/low” FMS levels	Varying scales and thresholds across studies; lack of consensus for classifying children by FMS level.	Basman (2019); Lai et al. (2014); Hardy et al. (2012)	Hinders meta-analyses and unified recommendations; underscores the need for internationally agreed-upon norms.
FMS as a tool for program monitoring	FMS assessments used to evaluate the effectiveness of instructional/training programs and the quality of the educational environment.	Lubans et al. (2010); Hulteen et al. (2018)	Allows not only child diagnostics but also assessment of PE systems, schools, clubs, and coaching programs.

Table 10. Practical Guidelines for FMS Assessment

Practical Question	Recommended Approach
What should be used for school-based pedagogical interventions?	TGMD-2 / TGMD-3 + pedagogical observation of movement technique
How to identify children at risk of motor impairments?	MABC-2 / BOT-2 + teacher/parent questionnaires
How to assess complex movements (acrobatics, martial-arts strikes)?	Video analysis + movement pattern-recognition models (Ivashchenko, Iermakov, Khudolii et al.)
How to use FMS for monitoring school programs?	Periodic FMS testing (1–2 times per year) + analysis of class/school-level dynamics

Discussion

The aim of this review was to summarize contemporary theoretical and empirical evidence on the development of fundamental movement skills (FMS) in children aged 5–12, to systematize the findings across the leading thematic domains, and to identify methodological gaps requiring further investigation. The analysis showed that FMS constitute a key foundation of motor development and determine subsequent success in learning technical motor actions, engagement in physical activity, and sport specialization.

First, an analysis of theoretical models demonstrates that international authors consider FMS as an integrated construct that encompasses locomotor, manipulative, and stability skills and is shaped by a child's coordination preparedness. It is emphasized that FMS form the basis of motor competence, which in turn is associated with physical activity and sport participation. This is supported by evidence showing that a child's ability to master technically complex movements, progress toward specialized sport actions, and maintain physical activity across the lifespan depends on FMS levels. However, despite a well-developed theoretical foundation, the analysis revealed a substantial lack of unified FMS assessment criteria, which hinders standardization and international comparability.

Second, the synthesis of empirical data indicates a consistent relationship between FMS proficiency, physical activity, physical fitness, and health. Children with insufficient motor competence demonstrate lower participation in physical activity, reduced confidence during motor tasks, and limited access to team games. This aligns with the international “negative spiral” model, according to which low FMS levels in early school age may determine sedentary behavior in adolescence. The review also confirms that FMS serve as an indicator of the quality of the educational environment: they are used for monitoring the effectiveness of school programs, predicting children's engagement in sport, and assessing the motor culture of the school population.

Third, the analysis of pedagogical strategies reveals that the most effective approach to developing FMS involves combining game-based models (active games, situational exercises, GEL approaches) with structured repetition modes. Game-based models promote motivation, social interaction, and technical–tactical variability, whereas structured repetition modes ensure controlled learning progression. The evidence file emphasizes that the regulation of load parameters (number of repetitions, rest intervals, task sequencing) is a decisive factor in instructional

effectiveness, especially for children aged 5–12. Empirical findings support the optimality of six-repetition modes with 60-second rest intervals, which yield the greatest improvements in manipulative skills in young children. Complementing these results, the Spectrum of Teaching Styles (Mosston & Ashworth) shows that effectiveness increases when game-based and repetition-based strategies are integrated into a coherent instructional decision chain—from reproductive styles emphasizing technical precision to productive styles fostering variability and autonomous movement decision-making.

Fourth, within the domain of programs designed to develop complex motor actions, the review identified strong effectiveness of sport-oriented interventions, including active games and exercises with elements of martial arts. These approaches contribute not only to technical skill development but also to improvements in physical qualities (strength, power) and social competencies. However, the effectiveness of such programs depends substantially on the professional competence of teachers and coaches, highlighting the need for specialized pedagogical training.

Fifth, the review identified the most significant methodological gaps. Chief among these are the absence of unified criteria for classifying FMS levels, inconsistencies across testing instruments, and insufficient validity of certain assessment procedures. Various scales (TGMD, MABC, BOT-2, Peabody, etc.) often produce divergent results for the same child population, making it impossible to construct a universal rating system. Additionally, many empirical studies have small sample sizes or insufficient statistical power, highlighting the need for further research with larger samples, clearly structured interventions, and controlled performance conditions.

In summary, the findings of this review fully align with the research objective. Theoretical approaches to FMS structure were synthesized, empirical evidence regarding their relationship with physical activity and health was systematized, effective pedagogical models and learning algorithms were described, and key methodological limitations impeding standardization in FMS development for children aged 5–12 were identified. The conclusions underscore the need for the development of internationally standardized assessment norms, more advanced intervention research, and closer integration of FMS into physical education and youth sports programs.

The review demonstrates that the development of fundamental movement skills in children aged 5–12 results from the interaction of three key factors: the structure of FMS themselves, the quality of pedagogical influence, and the characteristics of the educational environment. Their

coordinated interaction ensures effective development of motor competence.

The discussion confirms that FMS represent the foundation for subsequent motor, physical, and sports activity; insufficient FMS proficiency in early school years is associated with the emergence of a “negative trajectory” of motor behavior. The strongest evidence relates to the effectiveness of combining game-based learning models with structured repetition modes, which support optimal learning gains and maintain children’s motivation. The effectiveness of these models depends significantly on teacher competence and the availability of conditions for regular practice.

At the same time, the review identified a critical methodological gap – the absence of unified FMS assessment criteria, which complicates program comparison and the implementation of common standards. This highlights the need for further standardization of assessment tools and development of internationally harmonized norms.

Thus, the integrated model derived from the material positions FMS as a dynamic, manageable process that requires targeted pedagogical strategies, early screening, and a high-quality educational environment. It provides a conceptual foundation for designing effective school physical education programs and youth sport development pathways and requires further research.

Limitations

- This narrative review does not claim completeness, as it did not employ a full systematic protocol.
- Several studies included in the analysis had small sample sizes.
- The absence of unified FMS criteria complicates synthesis and generalization of findings.

Conclusions

The development of fundamental movement skills in children aged 5–12 is a critically important task in early sport training. The strongest evidence relates to game-based learning models, sensory integration, and structured repetition modes. It is essential to standardize FMS assessment criteria and consider sensitive periods of motor development.

Practical Recommendations

- Use game-based models (GEL, active games with martial-arts elements).
- Plan training loads according to optimal repetition modes.
- Apply a multisensory approach (visual, auditory, tactile stimuli).
- Develop manipulative skills from age 5 using a “simple → complex” progression.
- Provide regular monitoring of motor competence.

Future Research

- Development of unified criteria for FMS assessment.
- Examination of long-term effects of different learning models.

- Identification of sensitive periods for various FMS categories.
- Comparison of the effectiveness of game-based vs. technique-oriented methods.

AI Transparency Statement

AI-assisted software (ChatGPT, OpenAI, USA) was used solely as a technical tool during manuscript preparation—for language editing, stylistic improvement, and structuring of text based on material provided by the authors. No AI tools were used for data collection, statistical analysis, interpretation of results, or generation of original scientific findings. All aspects of the study, including problem formulation, study design, data analysis, and conclusions, were fully developed and critically evaluated by the authors.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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Формування фундаментальних рухових навичок у дітей 5–12 років: теорія, емпіричні дані та педагогічні моделі

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

Реферат. Стаття: 15 с., 10 табл., 39 джерел.

Історія питання. Фундаментальні рухові навички (FMS) є базовою основою моторного розвитку дітей і визначають здатність ефективно виконувати складніші спортивні рухи. FMS пов'язані з рівнем фізичної активності, здоров'ям, спортивною успішністю та довгостроковою траєкторією рухового розвитку. Водночас спостерігається значна різноманітність у визначеннях, педагогічних підходах та критеріях оцінювання FMS, що ускладнює стандартизацію навчальних програм.

Мета. Узагальнити сучасні теоретичні, емпіричні та педагогічні підходи до формування фундаментальних рухових навичок у дітей 5–12 років та систематизувати доказові моделі навчання у фізичному вихованні та початковій спортивній підготовці.

Матеріали і методи. Пошук літератури здійснено у базах Scopus, Web of Science, PubMed, ERIC, Google Scholar (2000–2025). Застосовано комбінації ключових слів “fundamental movement skills”, “motor learning”, “physical education”, “instructional model”, “manipulative skills”, “early sport training”. Додатково проведено сніжковий пошук за працями Barnett, Ivashchenko, Khudolii, Marchenko. До аналізу включено емпіричні дослідження, огляди, концептуальні моделі та програмні звіти; виключено клінічні вибірки та роботи без даних щодо FMS. Синтез виконано за доменами.

Результати. Виявлено чотири ключові напрями сучасних досліджень: (1) Теоретичні засади FMS. Виділено три категорії навичок (локомоторні, маніпулятивні, стабілізаційні), їх координативну основу та контекстуальну залежність від умов навчання. (2) Зв'язок FMS із фізичною активністю та здоров'ям. Високий рівень FMS асоціюється з вищою руховою активністю, кращою фізичною підготовленістю та нижчим ризиком ожиріння; маніпулятивні навички є найсильнішим предиктором спортивної участі. (3) Педагогічні моделі навчання. Ефективними є ігрові інтервенції (GEL-підхід), сенсорно-інтегративні методи, структуровані режими повторень і програмоване навчання складних рухів. (4) Маніпулятивні та складні рухові дії. Формування кидків, ловіння, ударів і ведення м'яча є центральною умовою включення дітей у спортивні ігри; оптимізація навантаження (6 повторень, паузи 45–60 с) забезпечує максимальний приріст навченості.

Висновки. Формування FMS у віці 5–12 років є ключовим компонентом фізичного виховання та початкової підготовки в спорті. Найефективнішими виявились комбіновані педагогічні моделі, що поєднують ігровий контекст, сенсорно-інтегративні стимули та структуровані режими повторення. Існує нагальна потреба у стандартизації критеріїв оцінювання FMS, уніфікації тестових інструментів та подальшому впровадженні цифрових методів аналізу рухів.

Ключові слова: фундаментальні рухові навички; моторна компетентність; фізичне виховання; педагогічні моделі; початкова спортивна підготовка.

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