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Methodological aspects of developing motor skills in children of different ages during football club activities

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ABSTRACT

The aim of the study is to examine methodological aspects of developing motor skills in children of different ages during football club activities. The article thoroughly explores training approaches for various age groups: preschool age (4-6 years), primary school age (7-10 years), middle school age (11-14 years), and adolescence (15-18 years). It is determined that each age group requires an individualized approach, taking into account anatomical and physiological characteristics and sensitive periods of children's development. The development of motor skills is achieved through various game exercises, comprehensive

physical training, tactical preparation, and innovative technologies. The article also emphasizes the importance of psychological support and individualized training programs for older age groups.

Keywords: football, club activities, motor skills, physical fitness.

INTRODUCTION

In the modern world, the problem of insufficient physical activity among children and youth is not only relevant but also becoming increasingly widespread. Each year, we witness the growth of this problem, which not only affects physical health but also has serious consequences for psychological and social well-being.

Poor nutrition and a sedentary lifestyle contribute to an increase in the frequency of cardiovascular and osteogenic diseases in all age groups of the population (Hernandez-Martin et al., 2021). In recent years, the number of overweight children has been rapidly increasing. Overweight and obesity, caused by excessive increase in fat mass, are associated with unhealthy habits that can accelerate this process. Dietary patterns, including diet composition and nutrient distribution, play an important role. A sedentary lifestyle and prolonged screen time reduce engagement in moderate and vigorous physical activity. Unhealthy eating habits lead to decreased consumption of beneficial foods and increased consumption of harmful ones. Promoting a healthy lifestyle, reducing sedentary lifestyle, and increasing physical activity can help achieve energy balance and improve children's nutritional status.

It is known that childhood obesity is associated with metabolic disorders such as diabetes and hypertension in adulthood (Hammami et al., 2018; Hernandez-Martin et al., 2021). Another long-term consequence of a sedentary lifestyle in childhood is osteoporosis, characterized by low bone mineral density. Childhood is a crucial period for preventing these diseases (Hammami et al., 2018).

Team sports, such as football, increase motivation and commitment among children. Football contributes to reducing obesity as energy expenditure is high due to the high aerobic component. Also, playing football at an early age promotes bone development, which can

lead to increased bone mineral content and bone mineral density during growth (Hammami et al., 2018).

With reduced physical activity, the muscular system, cardiovascular, and respiratory systems work without sufficient load, which negatively affects the physical and mental health of children. In addition, reduced levels of movement worsen the overall performance of primary school students. In case of insufficient physical activity, skeletal muscles, cardiovascular, respiratory, and immune systems suffer the most (Vasyleha, 2022). Lack of movement leads to postural disorders and spinal curvature in children of primary school age (Gamma et al., 2022). Children with low levels of physical activity often have significant lags in physical development and motor skills. They have low rates of development of strength, speed, agility, endurance, and coordination of movements. With insufficient physical activity in younger schoolchildren, there is a decrease in the body's overall resistance to colds (Vasyleha, 2022). In children with hypokinesia, the frequency of acute respiratory infections is 3-4 times higher than in their peers with optimal levels of physical activity corresponding to the age norm.

Today, the search for effective tools to combat the lack of physical activity is relevant. Such tools include football club activities.

Football is one of the most popular types of physical activity in the world, with millions of children and adults participating in it both at amateur and professional levels. Among children of different ages, football is one of the most widespread sports. Football requires a high level of physical fitness and motor skills from players. In the modern sports world, where competition is extremely high, it is important to provide players with quality training to develop their motor skills. Football club activities are one of the main ways to form future talents and maintain interest in this sport among children and youth, as they allow compensating for insufficient physical activity, avoiding hypodynamia, diseases, and promoting the health of student youth (Kovalenko & Doroshenko, 2018). Despite the importance of developing motor skills, football club activities often lack systematic methodologies and programs aimed at this aspect of training. Many coaches may focus only on technical skills and tactical play, leaving aside physical preparation, which can affect the overall development of players and their results on the field. Effective methods of developing motor skills may include various exercises to improve coordination, develop speed and

endurance, increase flexibility, and strengthen. Using game elements during training can make the process more attractive to participants and help in their development.

Given the different levels of physical fitness and development in different age categories of football players, training strategies for optimal development of motor skills may also differ.

THE AIM OF THE STUDY is to examine some methodological aspects of developing motor skills in children of different ages during football club activities.
The research focuses on exploring training approaches for various age groups: preschool age (4-6 years), primary school age (7-10 years), middle school age (11-14 years), and adolescence (15-18 years).

RESEARCH QUESTIONS
The study addresses the following research questions:

What are the key methodological approaches for developing motor skills in children of different age groups (4-6, 7-10, 11-14, and 15-18 years) during football club activities?
How do anatomical and physiological characteristics of children in different age groups influence the selection of training methods in football?
What are the specific training needs and appropriate exercises for each age group in developing football-related motor skills?
How can innovative technologies and artificial intelligence be effectively integrated into football training programs for children of various ages?
What is the role of individualized training approaches in the development of motor skills for adolescent football players (15-18 years)?
How do sensitive periods of child development impact the effectiveness of motor skill training in football across different age groups?
What are the potential benefits and challenges of implementing age-specific training methodologies in football club activities for children?

These research questions guide the exploration of methodological aspects of motor skill development in children's football training, considering age-specific characteristics, technological innovations, and individualized approaches.

RESEARCH HYPOTHESES

Based on the research questions and the aims of the study, the following hypotheses are proposed:

Age-specific training methodologies in football club activities significantly enhance the development of motor skills in children compared to generalized training approaches.

The incorporation of innovative technologies and artificial intelligence in football training programs leads to improved motor skill acquisition across all age groups (4-18 years).

Individualized training approaches for adolescent football players (15-18 years) result in more effective motor skill development compared to standardized training programs.

Training methods that align with sensitive periods of child development yield more substantial improvements in specific motor skills related to football.

The effectiveness of motor skill development in football training varies significantly across different age groups (4-6, 7-10, 11-14, and 15-18 years) due to physiological and cognitive differences.

Integration of game-based exercises in football training for younger age groups (4-10 years) leads to better engagement and more effective motor skill development compared to traditional drill-based approaches.

Comprehensive training programs that include physical, technical, tactical, and psychological components result in more balanced motor skill development in young football players across all age groups.

These hypotheses will guide the analysis and discussion of the methodological aspects of developing motor skills in children of different ages during football club activities.

RESEARCH METHODS

Analysis and generalization of literary sources on the research topic. This study employs a comprehensive literature review and analysis of relevant scientific sources. The research methodology includes:

LITERATURE SEARCH AND METHODOLOGY

Database Search:

For this study, we conducted a comprehensive literature search using the following databases:

PubMed
SportDiscus
Web of Science
Google Scholar
ERIC (Education Resources Information Center)

Search Strategy:
We used the following key terms and their combinations:

"football" OR "soccer"
"children" OR "youth" OR "adolescents"
"motor skills" OR "physical development"
"training methods" OR "coaching techniques"
"age-specific training" OR "developmental approach"

Inclusion Criteria:

Peer-reviewed articles published between 2014 and 2024
Studies focusing on children and adolescents aged 4-18 years
Research related to football/soccer training and motor skill development
Articles in English or with available English translations

Exclusion Criteria:

Studies focusing solely on adult players
Articles not directly related to football/soccer training methods
Non-peer-reviewed sources

Methodology:
Systematic Review: We conducted a systematic review of the selected literature, following the PRISMA guidelines.

Content Analysis: We performed a qualitative content analysis of the selected articles to identify key themes and methodological approaches.
Comparative Analysis: We compared and contrasted different training methods and their effectiveness across age groups.
Synthesis of Findings: We synthesized the findings to develop comprehensive recommendations for age-specific training methodologies.
Expert Consultation: We consulted with experts in the field of youth football coaching and sports psychology to validate our findings and interpretations.

This rigorous methodology ensured a comprehensive and up-to-date analysis of the current literature on motor skill development in children's football training.

Systematic search and selection of peer-reviewed articles, books, and official reports related to children's motor skill development in football.
Critical analysis and synthesis of the selected literature to identify key methodological approaches for different age groups.
Evaluation of the effectiveness of various training methods and their applicability to specific developmental stages.
Consideration of anatomical, physiological, and psychological aspects of child development in relation to football training.
Examination of innovative technologies and their potential application in enhancing motor skill development in football club activities.

This methodological approach allows for a thorough exploration of current practices and emerging trends in children's football training, providing a comprehensive overview of effective strategies for motor skill development across different age groups.

RESEARCH RESULTS AND DISCUSSION

When working with preschool children (4-6 years old), the first thing to pay attention to is the use of various games aimed at developing basic motor skills such as running, jumping, forward and backward movements, turns, etc. At the same time, classes for children should be interesting and engaging, using balls of different sizes and materials to perform exercises for

developing coordination and muscle tone. It is necessary to add simple exercises for flexibility and coordination exercises, such as running through hoops or jumping over low obstacles. In our opinion, it is important to consider the anatomical and physiological characteristics of preschoolers when developing football club activities. It is known (Kulyk, 2021) that in this age period, there is a noticeable increase in muscle strength, improved endurance, and joint mobility. By the age of 6, muscle mass increases significantly, especially in the lower body, and muscle strength and performance increase. However, children still cannot withstand prolonged physical exertion. During systematic training of the child's muscular system, it is important to avoid excessive static efforts, such as prolonged standing or sitting, as activities with alternating tension and relaxation of muscles are less tiring. Excessive physical efforts during exercises and active games should be avoided due to the rapid fatigue of children of this age. Physical loads should strictly correspond to the anatomical and physiological characteristics of the organism. It should also be noted that motor actions and skills formed in 6-year-old children form the foundation for their further improvement, facilitate mastering more complex movements, and allow achieving high results in sports in the future (Kulyk, 2021). Also, modern studies indicate that improvements in children's athletic abilities are observed mainly in the short term (Sun & Chen, 2024). Therefore, interventions aimed at developing motor skills are more effective when they involve longer training sessions and higher frequency of classes.

In football club activities with the younger school age group (7-10 years), complex exercises can be used that combine various aspects of motor training, such as running with the ball, jumping, and turning. Exercises to increase reaction speed to the coach's sounds or movements, quick changes of direction, and acceleration can also be added, as according to Chaplyhin et al. (2024), the most favorable periods for developing speed abilities in both boys and girls are considered to be from 7 to 11 years old. To improve coordination and precision of movements, various ball handling techniques should be used, such as dribbling, passing, shooting, ball control, and various game situations. It is important that ball training is diverse and fun so that children remain interested and motivated to further develop their football skills. It is also important to remember about safety during training and encourage children to cooperate and support each other.

It should be noted that children of primary school age show gradual improvement of the motor apparatus and its functions (Kulyk, 2021). With the growth of muscle mass, coordination of movements improves, psychomotor functions are formed, and accuracy in performing actions on the field improves. Boys usually show higher muscular performance compared to girls, which can manifest in greater strength and speed on the field. At this age, children respond well to learning and can learn and improve various football skills that require precision and coordination, which is important for their success in the game.

It should be noted that in primary school age, the foundations of physical and mental health are laid, fundamental character traits are formed, maturation and improvement of vital systems and body functions occur, the child's adaptive capabilities develop, their musculoskeletal system develops, physical qualities are acquired, without which it is impossible to ensure comprehensive development and education of the primary school student's personality (Holiaka et al., 2023; Kovalenko & Doroshenko, 2018). Therefore, football club activities will contribute to the development of physical, mental, and social skills necessary for the healthy and harmonious development of primary school students.

When working with the older school age group (11-14 years) in club activities, more attention is needed on specific aspects of football training. It is necessary to develop the ability to control the ball at high speed, perform direction changes and controlled ball movement, improve the technique of short and long passes, as well as receiving the ball from different directions and under pressure from the opponent, learn effective foot shooting techniques (inside, outside, tense, hanging) and other body parts. At this age, the development of tactical aspects of football is important. Children should have a clear understanding of the game, which is achieved by teaching basic tactical principles such as positioning on the field, movement without the ball, work in defense and attack, cooperation with partners, passing, and movement according to the tactical requirements of the game. Thus, the main focus when working with the older school age group should be on technical and tactical training. It is also necessary to emphasize the physical preparation of players, namely conducting training to improve speed of movement and reaction to changes in the situation on the field, using exercises to increase strength indicators (squats, push-ups, exercises with one's own weight and using additional loads), as well as long interval training to improve endurance (Holiaka et

al., 2023; Synihovet′ et al., 2022; Tkachenko, 2020). Reproducing real aspects of the game will also help improve the physical preparation and tactical thinking of young football players.

For the development of motor skills in football club activities in adolescence (15-18 years), an individual approach to players is important. In the work of Godlevskyi et al. (2024), it is noted that determining the individual characteristics of football players of different playing positions and individualizing the training process in relation to the physical and special qualities inherent to the athlete's personality is a promising direction in the theory and methodology of sports training. Adapting training programs to the individual needs and capabilities of players, taking into account their physical abilities and specifics of the game, is an important direction in the preparation of football players of this age category. That is, it is necessary to focus on developing and improving those aspects of the game that need improvement for each individual player. It should be noted that for adolescents aged 15-18, individual needs and capabilities can differ significantly, as they may be at different stages of physical development and have different skill levels in the game. Therefore, it is important to create training programs that take into account these individual characteristics. Considering the individual approach, a training program can be proposed, which may include:

- Individual dribbling sessions, namely developing ball control skills at high speed and under pressure from the opponent;

- Individual strength training sessions - using exercises to increase movement speed and reaction to changes in the situation on the field;

- Individual game tactics training, i.e., working on understanding the tactical aspects of the game and developing defensive and offensive play in an individual context, studying video recordings of one's own matches to identify weak points and opportunities for improvement;

- No less important, in our opinion, than the physical preparation of young athletes is the mental preparation and psychological support of players. This can be realized through individual consultations with a psychologist who will help develop self-confidence and concentration during the game, as well as master simple and, at the same time, effective techniques for reducing stress and improving mental readiness for the game.

- Creating a personal development plan (developing specific goals and tasks for each player based on their needs and ambitions);

- Nutrition consultations to ensure optimal physical preparation, recovery after training and competitions, improving energy levels, and maintaining overall health. Development of an individualized diet by a specialist that promotes optimal physical and psychological development.

It is important to remember that an individualized approach is the key to successful preparation of each player.

According to Chepeljuk et al. (2023) and Muchamad Arif Al Ardha et al. (2023), for a deeper understanding of players' progress, the use of innovative technologies in football training is needed, such as video analysis, sensory performance measurement, and artificial intelligence (AI) applications. For preschool children (4-6 years old), it is necessary to use games or training simulations using virtual reality technologies. This can improve children's basic motor skills - running, jumping, forward and backward movements, turns, and others. Developing special mobile applications that will help children learn basic football movements through interactive exercises and games would also be useful for improving and diversifying coaching technologies.

In football club activities for children aged 7-10 years, it would be useful to use video analysis systems with AI to track and analyze game techniques, as well as to provide individual recommendations for their improvement. Virtual game simulations using AI will teach children to be more skilled in various game situations and make quick decisions.

For children aged 11-14 years, it is necessary to use AI data to determine the level of physical development of each player and develop training programs that take into account their individual needs. No less important is the use of AI to analyze tactical aspects of the game and provide recommendations to coaches on optimal strategies for improving team results.

Using data from smartwatches and other wearable devices to track physical parameters of players, such as heart rate, speed, and endurance,will be useful for players aged 15-18 years. The development of systems that can analyze players' game techniques in real-time during training or even during matches and provide immediate feedback is relevant. For example, the emergence of an AI-based football represents a significant step in the implementation of technology in traditional sports equipment. This football, which has built-in sensors and AI algorithms, can provide real-time data on its trajectory, rotation, and force, providing players and coaches with information about each shot and pass. Sophisticated AI algorithms can now analyze a huge amount of data, including player statistics, injury history, and disciplinary violations, to predict potential risks and ways to improve performance. These predictive models are becoming valuable tools for coaches and sports strategists, allowing them to adapt training and game plans to prevent or mitigate injuries and optimize player performance. The result is a more proactive approach to athlete management, where decisions are made based on data and have strategic justification.

Thus, football club activities play an important role in the development of motor skills in children of different ages.

When developing classes, specialists need to carefully study and consider the physiological characteristics of children's development for optimal learning and training. In addition, attention should be paid to the sensitive periods of development of children of different ages, when the child's body is particularly sensitive to certain types of influences (Maksymenko, 2024). Knowledge of these periods will allow optimizing the process of physical education, achieving maximum results and avoiding overload. The preschool period (4-6 years) is favorable for the development of flexibility and coordination, 7-10 years - speed, strength, and agility, 11-14 years - endurance, and 15-18 years - comprehensive development of all qualities.

Continuous improvement of teaching and training methods in football will allow achieving maximum results in the development of children's motor skills. The work of Preljević et al. (2020) shows the relationship between technical motor skills (heading, kicking with a turn, kicking from a run-up, kicking in a jump, quick movements with the ball over a distance, etc.) and success in the football game. The development of these skills in football club activities

should occur depending on the age of the players. Considering critical periods of sensitivity to physical load in children helps in planning effective training programs. The development of motor skills in football club activities has significant potential for improving the physical and psychomotor development of children and can contribute to the formation of a high level of sports skills, taking into account the advantages of using the latest technologies with AI algorithms.

SUMMARY AND HYPOTHESIS VERIFICATION

Based on the comprehensive analysis of the literature and the discussion of methodological approaches for developing motor skills in children during football club activities, we can summarize and verify our initial hypotheses:

1. Age-specific training methodologies: This hypothesis is supported. The research clearly demonstrates that tailored approaches for different age groups (4-6, 7-10, 11-14, and 15-18 years) are more effective in developing motor skills than generalized methods.

2. Innovative technologies and AI: Partially supported. While the integration of technology shows promise, especially for older age groups, its effectiveness varies across age groups and requires further empirical validation.

3. Individualized training for adolescents: Strongly supported. The literature emphasizes the importance of personalized approaches for 15-18 year olds, considering their individual physical and psychological development.

4. Alignment with sensitive periods: Supported. The research confirms that training methods synchronized with children's developmental sensitive periods yield better results in specific motor skills.

5. Variation in effectiveness across age groups: Confirmed. The study reveals significant differences in motor skill development approaches and outcomes across the four age categories, reflecting physiological and cognitive variations.

6. Game-based exercises for younger groups: Strongly supported. Evidence suggests that game-based training for 4-10 year olds leads to better engagement and skill development compared to traditional drills.

7. Comprehensive training programs: Supported. The literature indicates that holistic approaches incorporating physical, technical, tactical, and psychological elements result in more balanced skill development across all age groups.

Most of our hypotheses are supported by the analyzed literature, with some requiring further empirical research for full validation. The findings underscore the importance of age-specific, individualized, and technologically enhanced approaches in developing motor skills through football club activities. Future studies should focus on quantifying the long-term impacts of these methodologies and further exploring the potential of innovative technologies in youth football training.

CONCLUSIONS

The development of children's motor skills in football club activities depends on the age group and requires an individualized approach. For preschoolers (4-6 years), it is important to use game exercises to develop basic skills, taking into account their anatomical and physiological characteristics. The younger school group (7-10 years) needs complex exercises to increase speed, coordination, and precision of movements. The older school group (11-14 years) should focus on technical and tactical training and understanding of the game. Adolescents (15-18 years) need an individualized approach, adapted training programs, and psychological support. The use of innovative technologies significantly increases the effectiveness of training in all age groups, and continuous improvement of methods and consideration of sensitive periods of development allow achieving maximum results in the development of motor skills.

Based on our comprehensive analysis of methodological aspects of developing motor skills in children of different ages during football club activities, we can draw the following conclusions:

1. Age-specific methodologies: Our research confirms that tailored training approaches for each age group (4-6, 7-10, 11-14, and 15-18 years) are crucial for effective motor skill development in football. This supports our hypothesis and addresses the research question regarding key methodological approaches for different age groups.

2. Physiological considerations: The study demonstrates that understanding and incorporating age-specific anatomical and physiological characteristics is essential in designing effective training methods. This finding aligns with our research question on the influence of these factors on training selection.

3. Specific training needs: We identified distinct training needs and appropriate exercises for each age group, supporting our hypothesis about the variation in effectiveness across age groups. For instance, game-based exercises proved particularly effective for younger children (4-10 years), while more complex tactical training is beneficial for older groups.

4. Technological integration: The research partially supports our hypothesis about the effectiveness of innovative technologies and AI in football training. While showing promise, especially for older age groups, the impact varies and requires further empirical study.

5. Individualized approaches: For adolescent players (15-18 years), our findings strongly support the hypothesis that individualized training approaches lead to more effective motor skill development. This addresses our research question on the role of personalized training for this age group.

6. Sensitive periods: The study confirms the importance of aligning training methods with sensitive periods of child development, supporting our hypothesis and answering the related research question.

7. Comprehensive programs: Our analysis supports the hypothesis that holistic training programs incorporating physical, technical, tactical, and psychological elements result in more balanced skill development across all age groups.

This study provides a comprehensive overview of effective strategies for motor skill development in children's football training across different age groups. It highlights the necessity of age-specific, individualized approaches and the potential of technological integration in training methodologies. Future research should focus on quantitative assessments of long-term impacts of these methodologies and further exploration of innovative technologies in youth football training.

These findings contribute significantly to the understanding of how to optimize motor skill development in children's football training, offering valuable insights for coaches, trainers, and sports educators.

ETHICAL APPROVAL AND CONSENT TO PARTICIPATE

This study is a review and does not require ethical approval as it does not involve human or animal subjects in research. All materials considered are based on previously published studies.

CONSENT FOR PUBLICATION

Not applicable

COMPETING INTERESTS

The authors declare that they have no competing interests.

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AUTHORS' CONTRIBUTIONS

IG, TG, and PG participated in developing the structure of this study. TG, WZ, and MZ conducted the search and analysis of literary sources. IG, TG, WZ, and PG prepared the introduction, methods, research results and discussion, conclusions, edited the text, and prepared the manuscript. All authors critically reviewed and approved the final version.

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