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The Impact of a Bodyweight-Based Exercise Program (through Quadrupedal Movement Exercises) on Motor Competence and Functional Movement in Children Aged 8 to 10 Years

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A B S T R A C T

This study aimed to examine the effect of a bodyweight-based exercise program through quadrupedal movement exercises on motor competence and functional movement in children aged 8 to 10 years. In this quasi-experimental study, designed with a control group and pre-test–post-test format, 40 male participants aged 8 to 10 years from elementary schools in Bagh Malek County were selected. Participants were randomly assigned to either the intervention or control group. In the pre-test phase, functional movement and motor competence were measured using the Functional Movement Screening (FMS) test and the Pediatric Gross Motor Coordination Test, respectively. Subsequently, the intervention group participated in a bodyweight-based exercise program through quadrupedal movements for three 45-minute sessions per week over eight weeks. During this period, the control group attended only daily physical education classes. In each session, participants followed the bodyweight-based exercise protocol, which was presented through a pre-recorded video shown on a large display. All exercise sessions were conducted in groups and followed a specific system designed for these exercises, led by a certified instructor. Participants' techniques were monitored, and adjustments were made when necessary. Finally, the dependent variables were re-measured in the post-test phase. Statistical analysis was performed using paired t-tests to compare pre- and post-test scores within each group, and independent t-tests to compare changes between the intervention and control groups. The bodyweight-based exercise program through quadrupedal movement exercises improved motor competence and functional movement in the intervention group, showing that the intervention program effectively impacted various aspects of motor competence and functional movement patterns, with all changes being significant compared to the control group ($p \leq 0.05$). The bodyweight-based exercise program through quadrupedal movement exercises significantly improved motor competence and functional movement in children aged 8 to 10 years. Bodyweight-based exercises may serve as an effective intervention to enhance motor competence and functional movement in this age group.

Keywords: *Bodyweight exercises, quadrupedal movement exercises, motor competence, functional movement, children.*

1. Introduction

Increasing movement experiences through physical activity is considered a vital factor for the quality development of fundamental motor skills in children. This can affect various aspects of children's health (physical and psychological). Furthermore, learning and mastering fundamental motor skills is a prerequisite for learning more advanced and complex sports skills (1).

Motor competence, which refers to skill in performing a wide range of motor tasks, serves as the foundation for children's motor literacy and overall physical health. Various studies have shown that the social interaction and engagement of children who are competent and skilled in performing these motor tasks are higher than those of children with fewer movement experiences and lower motor competence (2). On the other hand, it has been suggested that individuals with lower developed motor competence are less physically active and have a relatively lower tendency to engage in physical activity (3). Review studies have also reported the beneficial effects of physical activity-based interventions on improving motor competence in children and adolescents (Loras, 2020). Studies have shown that highly developed motor competence during childhood and adolescence has the potential to enhance lifelong functional independence and quality of life (4). Additionally, the results of studies indicate a strong positive relationship between higher levels of actual motor competence and functional movement screening scores, as well as the subset of mobility in fundamental motor skills (5).

Moreover, functional movement, which refers to the quality of movement and the ability to effectively perform fundamental movement patterns, is also critically important as it affects daily activities, sports performance, and injury prevention (5). Considering that functional movement screening is a comprehensive method for assessing the quality of fundamental movement patterns to identify functional movement, movement asymmetry, and individual limitations (6, 7), and given that fundamental movement patterns directly impact individuals' physical activity capacity, mastering fundamental motor skills can increase the efficiency and intensity of physical activity while reducing the likelihood of obesity and associated issues (8). Recent studies emphasize the importance of early interventions in developing motor competence and functional movement patterns; therefore, programs focused on improving motor competence and functional movement are essential for promoting lifelong physical activity and preventing sedentary behavior (9).

One program that can help achieve these goals is bodyweight-based exercises, which are implemented in various forms and styles for children (10). From the perspective of human motor development, the effective use of one's own bodyweight plays a key role in physical maturation. In this process, external forces such as gravity and ground reaction, along with internal forces like muscle contraction and elasticity, influence the size, structure, and function of our body (11). One form of bodyweight-based exercise that is suitable, engaging, and fun for children is crawling exercises (12, 13).

Crawling exercises are an emerging form of bodyweight training that has gained popularity in the fitness industry. Crawling exercises involve positions and movements that mimic neural development sequences (14) and animal postures and movements (such as crawling, rolling, positional transitions, etc.). This type of exercise involves movements that mimic natural quadrupedal patterns, such as crawling, spinning, and climbing, which are inherently functional and engage multiple muscle groups simultaneously. Many elements of crawling exercises are used in the rehabilitation of physical injuries and neurological diseases (6, 7, 14-16). Crawling exercises, as a bodyweight-based training program, have emerged as a promising approach to enhance motor competence and functional movement in children (10, 13). One supporting hypothesis for these exercises is the central generative patterns that are common across all vertebrates and are believed to have an evolutionary origin (Katz, 2016). Central generative patterns control the connection between the hands and feet, leading to bipedal and quadrupedal movement patterns in humans and animals. Depending on body structure constraints, task-specific constraints, and environmental barriers, central generative patterns change through sensory input.

Currently, several commercial quadrupedal movement training systems exist. Among them, animal movement pattern exercises represent an innovative form of quadrupedal movement that incorporates dynamic quadrupedal movements that are combined with other

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exercises and eventually designed as a flow (a series of interconnected animal movement pattern exercises). Like other commercial quadrupedal movement systems, the animal movement pattern exercise system claims to improve flexibility, range of motion, strength and endurance, as well as cognitive skills and joint position sense (17).

Given the growing prevalence of sedentary lifestyles and reduced physical activity levels among children, the need for innovative training programs that can engage children and improve their motor competence is increasing. The quadrupedal movement exercise program and animal movement pattern exercises offer a unique approach based on play and fun that not only attracts children's interest and enthusiasm but may also lead to significant improvements in their motor competence and functional movement (13, 18).

Considering existing research, it is essential to develop motor skills and motor competence from an early age. However, to ensure long-term adherence to exercise, training sessions must be enjoyable (19); therefore, in the early stages of learning, fun-based activities should be designed to engage children, as research has shown that enjoyment and fun play a significant role in children's attitudes toward physical activity (20). These activities may be less structured than regular sessions, but coaches can use a constraints-based approach to ensure learning. Through the use of animal forms, children can learn motor skills in an enjoyable environment while the physiological adaptations required by the exercise are often hidden in the form of entertaining tasks. Animal forms can be taught separately to promote learning correct and safe movement patterns but can also be integrated into play-based activities (10).

Animal forms are primarily designed to enhance locomotor motor skills, but these skills are combined with the needs of manipulation and stability. Animal forms are used to develop fundamental motor skills like crawling, rolling, and balancing. While it may be expected that all children and adolescents can perform these movements, research suggests that a number of youth experience difficulty demonstrating competence in such fundamental motor skills (21). Coaches and teachers should periodically review these fundamental movements with children and adolescents as part of a training program since these movements provide a foundation for more advanced skills needed for sports performance (22, 23).

Another advantage of using animal forms is that children can relate to the movements of each animal, thereby learning motor skills without needing explicit instructions. Explicit knowledge typically occupies conscious attention or active memory resources (24), which can disrupt performance (25). Additionally, at early stages of development, children may lack the ability to interpret information logically and have limited memory capacity (26, 27); asking children to "imitate or pretend" may lead to better results. Teaching children to imitate familiar animal gestures and movements may help them learn the basic movement forms required in games and activities before formal training begins (18, 26). These movements create opportunities for creative and authentic expression of children's movements (Baumgarten et al., 2010).

Based on existing evidence, bodyweight-based exercises, especially crawling exercises, can significantly improve children's fundamental movement patterns, motor competence, and functional movement. However, sufficient research is lacking to confirm these claims for children. Crawling exercises, by combining play elements and imitating animal movements, not only increase children's engagement in physical activity but can effectively enhance their motor and physical development. Therefore, this study aims to assess the impact of crawling exercises on motor competence and functional movement in children aged 8-10 years, thereby contributing to the existing scientific evidence in the field of children's physical and motor health and enabling the design of more effective training and educational programs.

2. Methods and Materials

2.1. Study Design and Participants

This study employed a quasi-experimental design with pre-test and post-test measurements, including both an intervention and a control group. The aim of the study was to assess the impact of an eight-week bodyweight-based exercise program (quadruped movements) using an animal movement patterns training system on the motor competence and functional movement of children aged 8 to 10 years. The changes in outcomes between the groups were compared to determine the effect of the intervention.

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A total of 40 male participants, aged 8 to 10 years, were selected from elementary schools in Baghmolak County. The participants were randomly assigned to either the intervention group (20 participants) or the control group (20 participants). The inclusion criteria were children with no diagnosed physical or neurological conditions that could affect their motor abilities. Parental consent was obtained, and the study was approved by the Ethics Committee of the Institute, following the Helsinki Declaration (2006).

2.2. Measures

2.2.1. Gross Motor Coordination Test for Children

To assess motor competence, the Gross Motor Coordination Test for Children was used, a valid and recognized tool for evaluating motor coordination in children (28). This test includes four subtests that measure various aspects of motor coordination (balance, coordination, strength, agility, and lateral dominance): 1) maintaining body balance while stepping backward on balance beams of varying widths, 2) hopping on one foot over obstacles of varying heights, 3) jumping around with both feet together, and 4) moving wooden blocks in one direction. Each subtest is scored individually, and an overall motor score is calculated by summing the scores. The Gross Motor Coordination Test for Children has been shown to have high reliability and validity for assessing motor coordination in children aged 5 to 14 years.

2.2.2. Functional Movement Screening Test

This tool was used to assess movement patterns and identify limitations or asymmetries that might predict injury risk. The Functional Movement Screening includes seven movement tests: 1) active ankle raise (assessing hamstring flexibility, core stability, and active hip mobility), 2) trunk stability during push-ups (core stability and spine control, some upper body strength), 3) shoulder mobility (shoulder range of motion and internal and external rotation of both shoulders), 4) deep squat (mobility and stability of the hips, knees, ankles, and thoracic spine), 5) rotational stability (neuromuscular coordination and stability across the shoulders and spine), 6) step-over obstacle (bilateral movement of the hips, knees, and ankles in a single-leg stance), and 7) inline lunge (movement of the ankle, thigh, knee, and spinal stability). Each test is scored on a scale from 0 to 3, with a maximum possible score of 21. Details for performing each subtest were provided according to the standard instructions for the Functional Movement Screening Test, including the use of predetermined oral instructions for participants (6, 7, 29). The Functional Movement Screening Test has been widely used in clinical and athletic settings for evaluating functional movement patterns across various populations, including children (6, 7, 30).

2.3. Intervention

The intervention group participated in an eight-week bodyweight-based exercise program. Sessions were held three times per week, with each session lasting approximately 45 minutes. The program consisted of a series of bodyweight exercises based on natural quadruped movements and animal-like movements such as bear crawls, crab walks, and monkey walking (31). These exercises were selected for their ability to engage multiple muscle groups, improve coordination, and enhance neuromuscular control (13). In each session, participants worked with a pre-recorded instructional video displayed on a large screen. The program was implemented in a single phase (12). Each session began with a 10-minute warm-up, including dynamic stretches and fundamental movement exercises specific to the program. The main portion of the session involved structured quadruped and animal movement patterns that progressed in difficulty over time. The session concluded with a 5-minute cool-down, including static stretching. The control group did not engage in any additional physical activity except for their regular daily physical education classes.

Each session started with general dynamic stretches, followed by specific wrist mobility exercises, core activation exercises, shoulder exercises, special stretching forms, transitional movements, and finally, sections of combined movements. Instructions for executing the exercises were provided to the participants based on the relevant literature (31). All quadruped training sessions were conducted in groups and followed the animal movement pattern training system, guided by a certified trainer (Level 1 Animal Exercise Trainer) (12). Participant techniques were monitored, and adjustments were made as necessary to ensure correct technique and safety.

Each session of the intervention follows a structured sequence of mobility exercises, activation movements, specialized stretches, transitional movements, and flow exercises. The focus is on improving coordination, strength, flexibility, and neuromuscular control through animal-inspired movement patterns.

1. **Wrist Mobility**: The session begins with wrist mobility exercises to improve flexibility and joint function. Participants perform wrist rotations in both directions for 30 seconds each, followed by a wave-like wrist stretch for 30 seconds per direction. Lateral wrist stretches are done 5 times on each side, and front-back wrist stretches are performed 5 times. Finally, wrist rotations are completed 3-4 times in each direction.
2. **Activation Movements**: The activation phase includes various animal-inspired movements to engage multiple muscle groups. The first movement, "Animal 1," involves performing a crawl-like movement for 10-30 seconds on each side, repeated twice. "Animal 2" involves lifting one arm or leg while mimicking animal-like crawling for 15 seconds per movement, repeated twice. "Animal 3" continues the pattern with arm or leg lifts for 10 seconds per movement, performed twice. The "Crab" movements (Crab 1, 2, and 3) include crawling forward for 60 seconds, followed by arm or leg lifts for 15 seconds, and then 10-second intervals. Each variation is repeated 1-2 times, depending on the movement.
3. **Specialized Stretches**: After the activation movements, participants engage in stretches aimed at improving flexibility and mobility. "Wave relaxation" is performed twice, at a slow pace. The "Scorpion stretch" targets the hip flexors and lower back and is repeated twice for each leg. The "Crab stretch" focuses on the shoulders, back, and hips, performed 5-7 times per arm.
4. **Transitional and Shifting Movements**: This section involves movements designed to improve coordination and body control in transitioning between different positions. The "Underhand shift" involves crawling or shifting on the floor for 30 seconds, repeated 3 times. The "Full Scorpion" stretch involves holding a deep stretch for 30 seconds, repeated 3 times. The "Side jump strike" involves lateral jumping movements to build agility, performed 3 times for 30 seconds. Lastly, "Step forward with foot" is a simple dynamic movement, also repeated 3 times for 30 seconds each.
5. **Flow Sequence**: The final part of the session involves a dynamic flow of integrated animal movements to increase coordination, endurance, and fluidity of motion. The sequence includes deep monkey movements, underhand shifts, full scorpions, lateral jumps, crab stretches, and combinations of movements from the "Animal 1," "Animal 2," and "Animal 3" sequences. This flow is performed first 4 times to the right, followed by 3 repetitions to the left, and finally, 3 full animal movement patterns are performed continuously from right to left.

Each session lasts approximately 45 minutes and is repeated three times per week for 8 weeks, progressively increasing in intensity and complexity to enhance neuromuscular control and functional movement patterns (12).

2.4. *Data Analysis*

Data were collected at baseline (pre-test) and after eight weeks of intervention (post-test) for both the intervention and control groups. The researcher conducted the assessments of the Gross Motor Coordination Test for Children and Functional Movement Screening under standard conditions. The data were analyzed using SPSS version 25. Paired t-tests were used to compare pre- and post-test scores within each group, while independent t-tests were used to compare the changes between the intervention and control groups. A significance level of $p \leq 0.05$ was set.

3. Findings and Results

At the beginning of the study, there was no significant difference between the intervention and control groups in terms of demographic characteristics, including age, height, weight, and body mass index. These findings suggest that the

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groups were comparable at baseline, and any observed differences in the results can be attributed to the intervention (Table 1).

Table 1

Demographic Characteristics of Participants

p-value	Control Group (20 participants)	Intervention Group (20 participants)	Variable
0.73	8.6 ± 0.5	8.5 ± 0.6	Age (years)
0.59	131.0 ± 5.2	130.2 ± 5.4	Height (cm)
0.87	30.8 ± 4.9	30.5 ± 4.6	Weight (kg)
0.71	18.2 ± 2.3	18.0 ± 2.1	Body Mass Index

After eight weeks of intervention, the intervention group showed a significant improvement in motor proficiency as measured by the Gross Motor Coordination Test for children. The overall score on the Gross Motor Coordination Test for children in the intervention group significantly increased compared to the control group, indicating a positive effect of the exercise program (Table 2).

Table 2

Comparison of Gross Motor Coordination Test Scores for Children Before and After Intervention

p-value	Control Group (20 participants)	Intervention Group (20 participants)	Variable
0.83	87.9 ± 5.4	87.5 ± 5.2	Pre-test Total Score
0.001*	88.3 ± 5.1	94.8 ± 4.6	Post-test Total Score
0.001*	+0.4 ± 1.9	+7.3 ± 3.8	Change in Total Score

The intervention group also demonstrated significant improvement in functional movement as measured by the Functional Movement Screening Test. The overall score on the Functional Movement Screening Test in the intervention group significantly increased compared to the control group, indicating that the intervention program effectively improved functional movement patterns (Table 3).

Table 3

Comparison of Functional Movement Screening Test Scores Before and After Intervention

p-value	Control Group (20 participants)	Intervention Group (20 participants)	Variable
0.74	14.0 ± 2.3	14.2 ± 2.1	Pre-test Total Score
0.001*	14.3 ± 2.0	17.3 ± 1.8	Post-test Total Score
0.001*	0.3 ± 0.8	3.1 ± 1.4	Change in Total Score

Further analysis of the subtests of the Gross Motor Coordination Test for children revealed that the intervention group showed significant improvements in all components: 1. Balance maintenance while stepping backward on balance beams with varying widths; 2. Skipping on one leg and crossing obstacles of different heights—specifically jumping over obstacles while skipping on one leg; 3. Jumping in place with both feet together; 4. Shifting wooden boards in one direction. These findings suggest that the intervention program had a comprehensive effect on various aspects of motor proficiency:

Figure 1

Mean Scores of Both Groups on Four Items of the Gross Motor Coordination Test for Children

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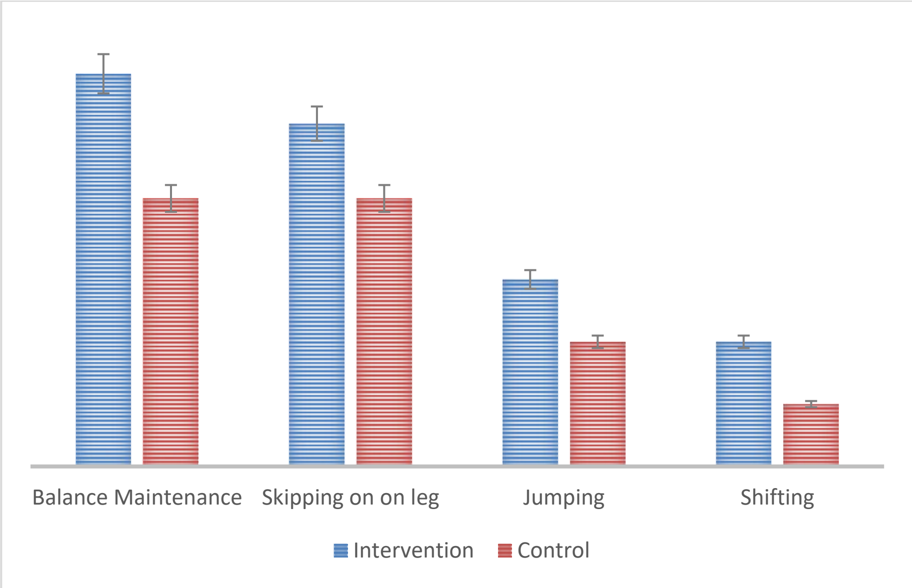

All P<0.01

4. Discussion and Conclusion

The present study aimed to evaluate the effects of an eight-week bodyweight-based crawling exercise program on motor competence and functional movement in children aged 8 to 10 years. To the best of the researcher's knowledge, this is the first study that investigates the effects of a bodyweight-based exercise program with a crawling approach on motor competence and functional movement in children aged 8 to 10 years. The results indicated that bodyweight-based exercises significantly improved motor competence and functional movement. These findings are consistent with previous research emphasizing the benefits of functional and motor exercises for the development of children's motor skills and fundamental movement abilities (32, 33). The results suggest that physical education programs incorporating functional exercises can effectively enhance certain physical fitness parameters in students, while also providing a new and alternative approach to improving students' physical fitness in physical education. Closed-chain exercises link joints and muscle groups to work together, making movement and exercise safer and more effective. Additionally, the study offers valuable insights into the potential benefits of bodyweight exercises for children. The present findings may help inform physical education programs and provide guidance on how to better use bodyweight exercises to enhance children's fundamental motor skills (34).

The significant increase in the gross motor coordination test scores observed in the intervention group suggests that bodyweight exercises effectively enhance motor competence. This is in line with studies highlighting the importance of diverse and complex movements in the development of motor skills during childhood (35). For instance, research has shown that interventions involving dynamic balance, jumping, and lateral movements—key components of the gross motor coordination test—can significantly improve children's motor competence (35).

Crawling movements, which involve coordination of the hands, feet, and core, are particularly useful for improving coordination and body awareness. These movements mimic natural developmental patterns, such as crawling, which are fundamental for acquiring motor skills in early childhood. Incorporating such movements into an exercise program is likely to aid in improving children's ability to perform complex motor tasks, as reflected in the gross motor coordination test scores (18, 22, 23, 26).

Significant improvements in the functional movement screening scores in the intervention group suggest that the exercise program also had a positive effect on functional movement patterns. Functional movement is crucial for performing daily and sports activities with efficiency and safety. Functional movement screening is widely recognized for its ability to identify movement deficiencies and asymmetries that may predispose individuals to injury (Cook et al., 2006). The improvements observed in this study align

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with similar findings reporting that exercises focused on movement quality and body control can reduce the risk of injury (26, 27, 36, 37).

The positive results observed in this study suggest that including bodyweight-based exercises in school physical education programs and training can have widespread benefits for children's physical development. These types of exercises, which focus on natural and functional movements, are particularly suitable for children who are still developing fundamental motor skills. By incorporating exercises that mimic early developmental patterns, teachers and coaches can help children improve their motor competence in a manner that aligns with their natural growth processes (22, 23).

Considering the significant improvements in motor competence and functional movement observed in the present study, teachers and coaches can incorporate bodyweight-based crawling exercises alongside other physical education programs. These exercises can easily and effectively be adapted to different skill levels and are suitable for various age groups and abilities. Moreover, the minimal equipment required for these exercises makes them accessible to schools with limited resources (26).

Coaches working with young athletes can also benefit from incorporating these exercises into their training programs. Improvements in motor competence and functional movement are essential for athletic performance, as they provide the foundation for performing sport-specific skills with accuracy and reducing the risk of injury (18, 22, 23). Crawling exercises can be particularly beneficial in sports that require agility, coordination, and body control, such as gymnastics, football, and basketball (10, 38).

Another important implication of the study's findings is the potential of bodyweight-based crawling exercises for preventing movement-related injuries in children. By improving functional movement patterns, such as those assessed by the functional movement screening, these exercises can help address deficiencies and asymmetries that may place children at risk for injury from physical activity. This presents a valuable tool for physiotherapists and sports coaches aiming to improve the safety and effectiveness of their training programs (5-7, 22, 23).

Beyond physical benefits, crawling exercises are inherently playful and engaging, which may be important for encouraging children to participate regularly in physical activity. The fun and challenging nature of these exercises can make physical activity a more enjoyable part of their daily routines, potentially helping to address the growing issue of sedentary behaviors among children (19, 39). Schools and community programs can capitalize on this and create engaging movement activities that encourage children to be more physically active (13, 22).

The findings of the study also indicate that the benefits of crawling exercises are not gender-specific, making them an inclusive option for physical education and training programs. The intervention group showed significant improvements in motor competence and functional movement, suggesting that these exercises can be effectively used across different demographic groups. This inclusivity enables teachers and coaches to implement a comprehensive and unified program that meets the needs of all participants.

Finally, the adaptability of crawling exercises makes them suitable for addressing the diverse developmental needs of children. Children with varying levels of motor competence can perform these exercises to their own ability, which may be beneficial in settings with different skill levels. This adaptability ensures that all children, regardless of their starting point, can experience improvement in performance and gain confidence in their physical abilities (22). By incorporating crawling exercises into existing programs, teachers, coaches, and physiotherapists can enhance the overall effectiveness of their efforts to promote physical growth, prevent injuries, and encourage long-term participation in physical activity among children.

There were several limitations in this study, including the small sample size, the age limitations of the participants, the lack of long-term follow-up, the absence of comparative analysis with other training methods, the failure to assess improvement mechanisms, the limitation of psychological and social evaluations, and the lack of an examination of gender differences. Based on these limitations, future research should include larger and more diverse samples to enhance the generalizability of the findings to different populations. Furthermore, investigating the long-term effects of the quadruped-based exercise program and assessing whether the improvements in motor competence and functional movement are sustained after the intervention period would be beneficial. Longitudinal studies could

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provide valuable insights into the sustainability of these benefits and their potential impact on physical activity levels and overall health in children over the long term.

Another topic that would be useful for future research is the comparison of the quadruped-based exercise program with other types of training interventions. This could help determine whether quadruped exercises are more effective or offer unique benefits compared to traditional exercise methods. In addition, examining improvement mechanisms, such as changes in neuromuscular coordination or cognitive-motor integration, could provide a deeper understanding of how these exercises contribute to motor development.

Finally, attention to the psychological and social aspects of the training program is also important. Assessing enjoyment, motivation, and engagement of children during the exercises could provide insights into how to optimize program design to increase participation and adherence. Including feedback from participants, parents, and teachers could lead to the development of more suitable and effective training programs that meet the needs of different groups of children.

The findings of this study suggest several practical applications for teachers, coaches, and physical therapists. The significant improvements in motor competence and functional movement highlight the value of incorporating quadruped-based exercises into physical education and youth training programs. These exercises are not only effective in improving motor skills but are also accessible and require no special equipment, making them feasible for a wide range of environments, including schools, sports teams, and community programs.

For physical therapists, the results emphasize the potential of bodyweight and functional exercises as a preventive strategy for reducing the risk of movement-related injuries in children. By improving functional movement patterns, such as those assessed by the Functional Movement Screen, these exercises can help address deficiencies and asymmetries that may lead to injury. Incorporating these exercises into rehabilitation programs may also support recovery and improve the overall quality of movement in young patients.

Authors' Contributions

M.F. conceptualized and designed the study, supervised the intervention sessions, and drafted the manuscript. M.B. contributed to data collection, analysis, and interpretation, and assisted in revising the manuscript. R.A. provided expertise in the development of the bodyweight-based exercise program and contributed to the literature review. B.M. conducted statistical analysis, supported data visualization, and ensured the methodological rigor of the study. All authors collaborated in the final review of the manuscript and approved its submission.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

The study placed a high emphasis on ethical considerations. Informed consent obtained from all participants, ensuring they are fully aware of the nature of the study and their role in it. Confidentiality strictly maintained, with data anonymized to protect individual privacy. The study adhered to the ethical guidelines for research with human subjects as outlined in the Declaration of Helsinki.

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