Enhancing locomotor skills in preschoolers through play jump rope

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ABSTRACT

Background: Fundamental Motor Skills (FMS), particularly in the Locomotor Skills domain, are an essential prerequisite for lifelong physical participation. However, the dominance of a sedentary lifestyle threatens young children's mastery of these skills.

Objectives: This study aims to test and prove the effectiveness of the jump rope play intervention program in improving locomotor skills in 5–6-year-old children.

Methods: This research uses a quasi-experimental one-group pretest-posttest design. The sample consisted of 19 males and 11 females, for a total of 30 children. Locomotor skills are measured objectively using the Locomotor subtest of the Test of Gross Motor Development-2 (TGMD-2). The Jump Rope Game intervention was implemented in a structured manner over 8 weeks (3 sessions/week). The data were analyzed using the Paired-Samples T-Test.

Results: The research results show a highly significant improvement in locomotor skills scores after the intervention. The average score increased from 23.30 on the pretest to 27.87 on the posttest, reflecting a 19.61% increase. The paired-samples t-test yielded a p-value of 0.000 ($p<0.05$), confirming that the difference between the two measurements was statistically significant.

Conclusions: Jump rope games have proven to be an effective, efficient, and enjoyable intervention for significantly improving young children's locomotor skills. This research recommends integrating inexpensive, easily accessible play-based activities into the early childhood education curriculum as a practical strategy to support physical literacy and address basic movement deficits.

Keywords: early childhood, fundamental motor skills, jump rope game, locomotor skills.

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INTRODUCTION

Fundamental Movement Skills (FMS) are essential for children's holistic development, impacting their physical, mental, and social well-being (Likhar et al., 2022). Locomotor skills such as running, jumping, and hopping are very important for FMS because they allow children to move and interact actively with their environment. This makes it a key predictor of children's lifelong participation in physical activity (Wintle, 2022). However, children's physical development today is very poor. Fundamental motor skills have declined due to increased sedentary behavior, driven by the increased use of electronic devices and reduced outdoor play time (Faigenbaum et al., 2015).

Preschoolers also had low FMS proficiency and spent less time engaging in active play (Demirhan et al., 2019). As a result, many kids fail to develop the fundamental motor skills expected for their age (Webster et al., 2019). This lack of FMS proficiency will have broader developmental implications, including motor issues and reduced fitness levels in later life (Lopes et al., 2021). To prevent long-term loss of motor abilities, research continues to highlight the importance of early implementation of targeted motor therapies.

Children who do not master fundamental locomotor skills tend to avoid physical activity and are at risk of developing a negative cycle that could potentially lead to long-term health problems (Barnett et al., 2024). Therefore, effective, accessible, and engaging interventions are needed (Goodway & Robinson, 2015). In the context of early childhood education, play is a natural medium for skill acquisition (Komaludin et al., 2025). Jump rope is the perfect choice because it biomechanically offers excellent plyometric training that targets limb strength, rhythm, and coordination, which are essential for locomotion. Cognitively, jump rope has been shown to improve executive function, particularly working memory and cognitive flexibility, especially in children with attention deficit/hyperactivity disorder (ADHD) (Kanzari et al., 2025). Additionally, jumping rope is explicitly mentioned as one example of a play activity that contributes to children's physical and sensory development (Garaigordobil et al., 2022).

Jump rope essentially requires locomotor skills (jumping and hopping continuously), coordination, balance, and rhythmic jumping (Fernandes & Hans, 2022). Its adaptability allows for variation and child engagement. Because this sport is internationally recognized, jump ropes can help with universal motor development (Norman et al., 2019). Although the benefits are clear, there is little empirical evidence that structured, varied jump rope programs effectively improve gross motor skills in preschool students. This is especially true for standardized assessments like the Test of Gross Motor Development-2 (TGMD-2) in preschool populations. However, there is more evidence regarding broader physical activity interventions.

The novelty of this research lies in shifting the focus from product-based quantitative outcome measures (such as duration and frequency) to the quality of process-based movement patterns specifically tailored to the preschool child's motor development stage. This distinguishes the intervention from most studies of school-aged children, which tend to emphasize strength or endurance protocols. This research aims to fill a literature gap by addressing the scarcity of process-oriented empirical data for the 5–6 age group and the limited objective evidence from the standard TGMD-2 instrument relevant to the natural characteristics of early

childhood. Through the Play Rope Jumping approach, this research fills that methodological gap by presenting a more flexible, valid, and targeted intervention design.

In research on the potential use of jump rope as a motor intervention, there is significant variation in the literature regarding the age of the study subjects (Barrio et al., 2023). Most existing research on the effectiveness of jump rope training focuses on school-aged children (7 years and older) (Singh et al., 2022), as it is easier to measure fitness levels and adherence to structured exercise protocols at this age (Chen et al., 2024). This implicitly leaves little objective evidence about how effective jump rope programs are for preschool-aged children (3–6 years old) (Andini et al., 2022). However, the preschool stage is very important for acquiring fundamental motor skills (FMS). This decline in data is due to methodological issues: research on young children requires specialized tools for measuring movement processes, and problems with test subject compliance often arise (Logan et al., 2018). Responding to this urgency, this study aims to test and document the effectiveness of the Jump Rope Game intervention program in improving locomotor skills in early childhood.

METHODS

Study Design and Participants

This research uses a quantitative approach with a one-group pre-post-test design. This design was chosen to investigate the effectiveness of a structured jump-rope play program in improving preschool children's gross motor skills. In this design, the gross motor skills of the same group of participants are assessed before (pre-test) and after (post-test) the jump rope intervention. Although this design is useful for identifying changes within the group, it must be acknowledged that without a control group, definitive causal inferences are limited (Grimshaw et al., 2000). However, this design serves as a valuable preliminary investigation to measure the potential impact of the intervention.

The participants of this study are 30 preschool children aged 4-6 years (average age 5 years 3 months) from kindergartens in Cimahi City, West Java Province, Indonesia. Practical sampling was used to select the participating kindergartens due to accessibility and willingness to participate. All children enrolled in learning groups A and B in the selected kindergarten who met the age criteria were invited to participate. Before data collection, parental consent was obtained for all participating children. Children with known physical disabilities or severe developmental delays were excluded from the study based on parental reports and teacher consultations, to ensure that the interventions and assessments were appropriate for their abilities.

Ethical approval statement

The research protocol for this study has been reviewed and ethically approved by the Research and Community Service Institute (LPPM) of STKIP Pasundan under certificate number 009/EC/LPPM-STKIPPAS/X/2025. This study was conducted in full compliance with the ethical principles outlined in the Declaration of Helsinki concerning research involving human subjects.

Given that the participants are children, special ethical considerations were strictly applied to ensure their protection, safety, and well-being. Written informed consent was obtained from parents or legal guardians prior to participation, and age-

appropriate assent was also obtained from the children. Participants and their guardians were fully informed about the study's objectives, procedures, potential risks, and benefits.

All procedures were designed to minimize potential risks or discomfort, ensure the confidentiality and anonymity of participant data, and uphold the right to withdraw from the study at any stage without consequences.

Research Instruments

Two primary instruments were employed in this study: the Test of Gross Motor Development–2 (TGMD-2) and a structured jump rope play module specifically designed for the intervention. The Test of Gross Motor Development–2 (TGMD-2) (Ulrich et al., 2000) is a standardized and widely validated instrument used to assess gross motor skills in children aged 3–10 years. In this study, the locomotor subtest was administered, consisting of six skills: running, sprinting, jumping, hopping, horizontal jumping, and sliding. Each skill was evaluated using process-oriented performance criteria, with a binary scoring system (1 = correct execution; 0 = incorrect execution). The TGMD-2 has demonstrated strong reliability and validity in previous studies (Valentini, 2012). All assessments were conducted by trained examiners who underwent prior calibration to ensure inter-rater consistency and minimize scoring bias.

In addition, a structured intervention module entitled "Playing with Various Jump Rope Activities for Preschool Children" was developed for this study. The module consists of ten variations of jump rope activities, ranging from basic two-foot jumps to more complex movements such as one-foot jumps, running over a long rope, and paired jumping. Each activity was systematically designed to target key components of gross motor development, including coordination, balance, rhythm, agility, and muscular strength. The module emphasizes play-based learning and progressive difficulty, allowing children to engage actively while developing motor competence at an individualized pace. It also includes detailed implementation guidelines covering activity duration, repetition, and safety considerations. The intervention was delivered by classroom teachers who received prior training from the research team to ensure consistency and fidelity of implementation.

Procedures

This study was conducted over 10 weeks and followed a structured pretest–intervention–posttest design. In Week 1, all participating children underwent a baseline assessment using the TGMD-2, which was administered individually in a quiet, designated area within the kindergarten environment. The assessments were conducted by trained examiners who were blinded to the intervention's specific objectives to ensure objectivity and reduce potential bias. Each assessment session required approximately 20–30 minutes per child.

The intervention phase lasted 8 weeks (Weeks 2–9), during which the structured jump rope play program was delivered 3 times per week, with each session lasting approximately 45 minutes. The sessions were integrated into the regular kindergarten schedule, primarily during outdoor playtime, to maintain ecological validity. Children participated in a variety of jump rope activities based on the developed module, under the supervision of trained classroom teachers. To ensure fidelity of

implementation, the research team conducted periodic observations and provided guidance when necessary.

Following the intervention, a posttest was conducted in Week 10 using the same TGMD-2 procedures as in the pretest. The assessments were administered by the same trained examiners and under comparable conditions to ensure consistency and reliability of measurement across time points.

Data Analysis

The collected data were analyzed using both descriptive and inferential statistical approaches. Descriptive statistics, including means and standard deviations, were calculated to summarize the characteristics of the data and provide an overview of children's fundamental motor skills (FMS) performance. Prior to inferential analysis, the data were screened to ensure compliance with statistical assumptions, including normality and homogeneity of variance.

To examine differences in FMS outcomes, an independent-samples t-test was used to compare mean scores between groups. This test was selected to determine whether there were statistically significant differences in motor skill performance following the intervention. The level of statistical significance was set at $p < 0.05$.

All statistical analyses were conducted using IBM SPSS Statistics 20, ensuring standardized and reliable data processing procedures.

RESULTS

This section presents the study's findings, beginning with the descriptive characteristics of the participants and then analyzing locomotor skill outcomes. Descriptive statistics are provided to offer an overview of the sample prior to further inferential analysis.

The demographic characteristics of the participants are summarized in Table 1. A total of 30 preschool children were included in the study. The mean age of the participants was 5 years and 3 months (SD = 6 months). Regarding gender distribution, the sample comprised 19 males (63%) and 11 females (37%), indicating a slightly higher proportion of male participants.

Table 1. Demographic Data of Participants

Participant Characteristics	N	Mean (SD) / Frequency (%)
Total Participants	30	
Age (years, months)		5 years 3 months (SD = 0 years 6 months)
Gender		
Male	19	63%
Female	11	37%

Table 2 shows a consistent improvement in participants' locomotor skills following the intervention. Beyond the increase in mean scores, the upward shift in both minimum and maximum scores suggests that improvements occurred across different ability levels, not only among higher-performing children. This pattern reflects a broad-based enhancement in motor competence rather than isolated gains.

Furthermore, the increase in post-test score variability (SD) may indicate that children responded to the intervention at different rates, which is common in early childhood motor development contexts. Nevertheless, the overall positive trend indicates that the structured jump-rope activities provided sufficient stimulus to

facilitate meaningful development of locomotor skills. These findings support the effectiveness of play-based, progressively structured physical activity interventions in enhancing fundamental motor skills among preschool children.

Table 2. Descriptive Statistics of Locomotor Skill Scores Before and After the Intervention (TGMD-2)

Measurement Stage	Number of Participants (N)	Minimum Score	Maximum Score	Mean	Standard Deviation (SD)	Average Improvement (%)
Pre-test (Baseline)	30	18	32	23.30	3.96	-
Post-test (After Intervention)	30	20	36	27.87	4.37	**19.61%**

Table 3. Paired Samples t-Test Results Comparing Pretest and Posttest Locomotor Skill Scores

Fit Index	Cut-off value	Model Value	Evaluation
Chi-Square	< 2230,280 (df=2122)	3404,056	Not Fit
Significant Probability	≥ 0.05	0.000	Not Fit
RMSEA	≤ 0.08	0,048	Fit
GFI	≥ 0.90	0,731	Marginal Fit
AGFI	≥ 0.90	0,711	Marginal Fit
CMIN/DF	≤ 2.0	1,604	Fit
TLI	≥ 0.90	0,915	Fit
CFI	≥ 0.90	0,918	Fit

The results of the paired-samples t-test indicate a statistically significant difference between the pretest and posttest locomotor skill scores (Table 3). The magnitude of the mean difference reflects a substantial improvement following the intervention, suggesting that the jump rope program had a meaningful impact on children's motor skill development.

The obtained p-value ($p < 0.001$) confirms that the observed improvement is unlikely to have occurred by chance. This finding provides strong empirical support for the intervention's effectiveness in enhancing locomotor skills among preschool children. Therefore, the research hypothesis is supported.

DISCUSSION

The main objective of this study is to test the effectiveness of the Jump Rope Play intervention program in improving the locomotor skills of early childhood children. The research results convincingly support the hypothesis, as evidenced by a statistically significant improvement in locomotor scores (p=0.000). The average score increased substantially from 23.30 (Pre-test) to 27.87 (Post-test), indicating that the four-week game-based jump rope intervention was highly effective. This increase not only demonstrates an improvement in basic jumping ability but also the child's ability to regulate rhythm, timing, and dynamic balance, which are essential components of locomotor mastery.

The principles of strength and coordination, as well as biomechanics literature, indicate that this program is running well. The muscle stretch-shortening cycle in the lower limb muscles is the focus of repetitive jumping movements in jump rope (Barrio et al., 2023). This repeated stimulation is crucial for increasing muscle power and elasticity, which are necessary for more efficient locomotor performance (Chen & Wu, 2022). This study adds to previous evidence and confirms that jump rope is

physiologically beneficial for preschool-aged children, a group whose locomotor skills are developing rapidly.

Specifically, the observed improvement in locomotor skills (jumping, hopping) is directly attributable to the intrinsic nature of jump rope activities, which largely involve repetitive, rhythmic jumping (McGann et al., 2020). This activity provides many opportunities for children to practice and refine lower-body coordination, balance, and propulsion (Anggraini, 2025). The improvement of motor skills and bilateral coordination can be indirectly enhanced through the timing and coordination required to manipulate the rope during swinging and to maintain rhythm (Trecroci et al., 2015). However, this is not directly related to improving object control abilities, which are fundamental for many object control tasks (Huang et al., 2024). Moreover, many variations of jump rope often include elements that implicitly enhance body awareness and spatial reasoning, which are crucial for effective object manipulation.

The use of a game context (game-based) rather than formal training is a specific contribution of this research. Game-based jump rope encourages children's natural desire to practice regularly, which is important for automating their motor skills (Deng et al., 2024). Additionally, jump rope requires precise synchronization between rope swings, rhythm, and jumps (Huang et al., 2022). To adjust their movements to this rhythm, children practice visuomotor coordination and timing, which are important components that often pose obstacles in mastering complex locomotor skills such as skipping or galloping (Warmansyah et al., 2024).

Theoretically, these findings support Dynamic Systems Theory (Torrents & Balagué, 2018). Jumping rope requires children to optimize and reorganize their motor systems. Measurable improvements in locomotor skills indicate that the child's musculoskeletal system and task demands are working together, such as when jumping over a moving rope. This enhances the exploration and selection of movement solutions, which helps them master their skills (Zhao et al., 2023). By introducing a variety of jump rope activities, this intervention effectively manipulates task constraints, encouraging children to explore new movement solutions and adapt their motor patterns (Huggett & Howells, 2024).

By offering a variety of increasingly challenging activities, structured jump rope modules effectively manipulate the "task" constraint (Storli & Lorås, 2025). Children are encouraged to explore various movement solutions and adapt their motor patterns. This increases movement variability, which is not considered a disturbance but is an important part of healthy exploration and flexibility in the motor system, leading to stronger skill development. Game-based interventions encourage children's engagement and practice by tapping into their intrinsic motivation (Glass & Galati, 2025).

The success of the jump rope intervention is also consistent with the established principles of Motor Learning Theory (Wulf & Lewthwaite, 2016). This program offers many practice opportunities; the 8-week intervention with regular sessions provides numerous repetitions of key movements, which are crucial for automation and skill enhancement (Goodway & Robinson, 2015). This program incorporates various jump rope activities (such as running, two-footed, one-footed, etc.) to provide a diverse training context. These varied exercises are known to enhance learning and the transferability of skills across different situations, making them more adaptive

and resilient (Hulteen et al., 2017). The inherent nature of skipping rope provides immediate feedback, such as a sense of rhythm and the ability to jump over the rope, even though it is not explicitly explained. External feedback, or facilitator guidance, will more directly direct performance. This combination of feedback greatly aids motor learning. Fun, accessible, and possibly innovative jump rope activities encourage children to engage. High motivation has been shown to enhance motor learning and practice perseverance, resulting in better performance.

In line with the emphasis on accessible physical interventions, this study provides empirical evidence that complements Ludyana et al. (2022), which emphasizes the importance of locomotor movement abilities at an early age as a reference for motor development as children get older. We offer a tested intervention model using standard instruments (TGMD-2) that physical education teachers in the field can replicate.

The results of this study have direct and important implications for early childhood learning, as rope skipping intervention should be systematically integrated into preschool physical activity programs. This offers a cost-effective, easily accessible, and sustainable alternative to expensive sports equipment. Educators will have evidence that game-based programs can significantly improve locomotor skills (Rahmanifar et al., 2025), allowing them to focus on fun, repetitive practice rather than rigid exercises.

Limitations of the study

The main limitation of this study is the use of a single-group pre-post-test design, which limits the ability to fully isolate the intervention's effects from maturation and the Hawthorne effect. Therefore, future research is suggested to: (1) Use a control group design to strengthen internal validity; (2) Conduct longitudinal studies to assess the retention (durability) of acquired locomotor skill improvements; and (3) Test the effectiveness of jump rope by comparing it with other FMS interventions.

CONCLUSION

This study provides empirical evidence that the jump-rope-based intervention program (Play Jump Rope) is effective in enhancing locomotor skills among preschool children. The findings demonstrate that structured, repetitive, and play-based physical activities are developmentally appropriate strategies for supporting motor coordination and overall movement competence in early childhood. The observed improvements highlight the potential of integrating enjoyable and skill-oriented activities to optimize motor development during critical growth periods.

In addition to its effectiveness, the intervention offers practical advantages, as it is low-cost, easily implemented, and adaptable to various educational settings. Therefore, incorporating structured jump rope activities into early childhood physical education curricula is strongly recommended as a sustainable approach to promoting physical literacy from an early age. This is particularly relevant to addressing the growing concern about reduced physical activity among children, driven by increasingly sedentary lifestyles.

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AI DISCLOSURE STATEMENT

During the preparation of this manuscript, the authors used DeepL Translate in combination with Google Translate and Grammarly to support translation, grammar checking, and language refinement. All generated outputs were carefully reviewed and edited by the authors to ensure accuracy, clarity, and adherence to academic standards. The authors take full responsibility for the content of this manuscript.

DATA AVAILABILITY

The empirical data supporting the findings of this study are contained within the manuscript and its supplementary materials. Additional detailed datasets or raw data used for the structural equation modeling are available from the corresponding author upon reasonable academic request.

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CONFLICT OF INTEREST

The authors hereby declares that this research is free from conflicts of interest with any party.

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