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The Effect of Traditional Jump Rope Games on Leg Muscle Strength of Elementary Students

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Abstract

This study aims to examine the effect of jump rope on leg muscle strength in physical education classes for sixth-grade elementary school students. Traditional games are movement-based activities designed to support students' physical development through active participation. A quantitative approach with a quasi-experimental nonequivalent control group design was used in this study. Participants were sixth-grade students divided into an experimental group (n = 23) and a control group (n = 24). The experimental group received physical education through the traditional jump-rope game, while the control group received conventional instruction. Before the analysis, normality and homogeneity tests were conducted to determine the appropriate statistical procedure. Leg muscle strength was measured using a vertical jump test administered at the pretest and posttest. Data analysis focused on group differences using the Mann–Whitney test on change scores (posttest–pretest). The Mann–Whitney test results showed a U value of 176,000, Z = -2.279, and a p-value of 0.023 (< 0.05), confirming a significant difference between the experimental and control groups. These findings indicate that the traditional jump-rope game is effective at increasing leg muscle strength. This study was limited to leg muscle strength; further research could explore the broader impact on other motor skills and across different educational contexts.

Keywords Jump Rope, Leg Muscle Strength, Physical Education, Traditional Games.

INTRODUCTION

Physical Education, Sports, and Health (PJOK) is an integral part of the education system that plays a key role in shaping students' holistic development. Given the Law Number's key role in shaping students' holistic development, Article 45 requires every educational unit to provide learning that supports students' physical, mental, social, emotional, and psychological growth. The success of PJOK implementation is highly dependent on the availability of adequate facilities and infrastructure, because with sufficient sports facilities, physical education, health, and recreational activities can be conducted opt (Ashari et al., 2022). One important component of physical fitness that needs to be developed is leg muscle strength, which plays a role in supporting basic motor skills such as running, jumping, and maintaining balance. Students with low leg muscle strength tend to have difficulty performing physical activities optimally (Rosita et al., 2019).

Strength is the ability of muscles to overcome loads in performing activities (Rohman et al., 2021). Strength is a very important component for improving a person's physical condition holistically. Muscle strength is the body's ability to use power, so a player must have leg muscle strength before training to develop other elements (Syafikri et al., 2023). According to Harsono in Alief Lam Akhmady; Ardiansyah Nur; Stanfor Rafles Souw (2022), muscle strength functions as a driving force in every physical activity, protects individuals from injury, and improves physical performance. Leg muscle strength refers to the ability of the leg muscles to accept loads during physical activity through muscle contraction. According to Agus Mukholid in Nur & Bakar (2021), strong leg muscles greatly affect explosive power, balance, and the efficiency of body movement. Lower limb muscle strength is an important component of physical fitness that supports students' daily physical activities and can be measured in a simple, practical, and objective manner (Jurdila et al., 2023).

According to Sukadiyanto in Nasrulloh (2022), exercise is a systematic, planned, programmed, measurable, regular, and repetitive process to improve or maintain physical fitness components. With this theoretical basis for exercise, leg muscle strengthening can be carried out in a targeted, scientific manner to support students' basic motor skills. Yoda et al. (2023) also emphasize that exercise is a process of physical activity carried out in a planned, systematic, and repetitive manner with the aim of improving physical abilities, particularly components of physical condition such as strength, leg muscle power, and agility, thereby supporting improved movement performance.

Previous studies have shown that leg muscle strength can be improved through conventional exercises such as running, jumping, plyometrics, and bodyweight training conducted systematically (Rizki Pebrian et al., 2022; Ayu Yuri Ramayanti et al., 2025). These exercises have been proven effective in improving physical condition and supporting overall health. Physical activities that involve coordination and leg muscle strength also play an important role in improving students' locomotor skills (Lin et al., 2022). Jumping rope exercises have been shown to have a positive effect on improving students' leg muscle strength and balance (Cant et al., 2023), as well as supporting the development of fundamental movement skills, especially locomotor abilities and movement coordination (Chen et al., 2026).

Although conventional approaches have been proven to increase leg muscle strength, these methods tend to be repetitive and teacher-centered, thus lacking variety and enjoyment in learning. Research in the field of physical education shows that skipping exercises have a significant effect on increasing leg muscle power (Saputra et al., 2024). However, research on the application of traditional games, particularly jump rope, in the context of elementary school physical education is still very limited. This condition indicates a research gap that needs to be filled through empirical studies on the effectiveness of the traditional jump rope game as a more varied learning strategy that is in line with the developmental characteristics of students.

Game-based learning is also related to motor learning theory. Rahantoknam in Rianto et al. (2023) defines motor learning as the improvement of motor skills acquired through practice or experience, rather than through maturation or physiological fluctuations. Games are an effective tool for training coordination, balance, and body movement control. Jump rope is a traditional game that has been popular among children since the 1980s (Ken Achroni in Widiyanti et al., 2021). This game is not only culturally valuable, but also has benefits in improving children's motor, social, and emotional development (Durojaiye in Andini et al., 2022). The repetitive jumping activity in this game can improve students' explosive power, balance, and kinesthetic intelligence (Fitria & Chikmah, 2024). The jump rope game is also known by various names in Indonesia, such as “yeye” in Java, “tali merdeka” in Sumatra, and “mappadendang” in Sulawesi, which shows the cultural richness of this traditional game (Wijaya et al., 2025). Additionally, the Ministry of Education and Culture, through the Indonesian Physical Fitness Test (TKSI) approach, emphasizes the importance of physical learning based on creative, participatory, and meaningful activities Kementerian Pendidikan Riset, dan Teknologi (Kemdikbud), 2023).

Observations and interviews at SDN 3 Sukamenak showed that PJOK learning in grade VI had been going well and students showed high enthusiasm. However, the learning methods were still dominated by basic physical fitness exercises such as running, jumping, and throwing, with limited facilities and minimal game variety. Data on students' basic leg strength scores show that most are in the moderate category (grade B), some are in the low category (grade C), and only a few have reached the high category (grade A). This condition confirms the need for more varied and enjoyable learning strategies to improve students' leg muscle strength.

Thus, the novelty of this study lies in examining the effectiveness of the traditional jump rope game as a game-based learning strategy to increase leg muscle strength. Theoretically, this study is expected to strengthen the application of learning theory, Piaget's cognitive development theory, and motor learning theory in the context of PJOK (Asri, 2025). In practice, this study is expected to provide alternative learning strategies that are more engaging, applicable, and appropriate to students' developmental stage. Specifically, this study aims to determine the effect of traditional jump rope games on the leg muscle strength of sixth-grade students at SDN 3 Sukamenak.

METHOD

This study used a quantitative, quasi-experimental design. The research design applied was a nonequivalent control group design, which aimed to examine the effect of the traditional jump rope game on students' leg muscle strength in Physical Education, Sports, and Health (PJOK) learning. In this design, the study involved two groups: the experimental and the control. Both groups were given a pretest to measure the students' initial leg muscle strength. Next, the experimental group received PJOK learning with traditional jump rope games, while the control group received conventional PJOK learning. After the treatment period, both groups were given a posttest to assess changes in leg muscle strength.

The research subjects were all 47 sixth-grade students at SDN 3 Sukamenak in the 2025/2026 academic year. The sampling technique used was total sampling, so that the entire population was used as the research sample. The students were then divided into two groups: 23 in the experimental group and 24 in the control group. The division was based on existing classes, so that the groups were not completely equivalent, in accordance with the characteristics of a nonequivalent control group design.

To obtain valid data aligned with the research objectives, several complementary data collection instruments were used. These instruments were selected to provide a comprehensive picture of the students' leg muscle strength and to support a more in-depth analysis of the influence of the traditional jump rope game on physical education learning. By using multiple instruments, it is hoped that the research results will be more accurate, objective, and consistent with established indicators. The instruments used in this study consist of:

A. Research Instrumen

Tests were used as the main technique to measure students' leg muscle strength before and after treatment. Measurements were taken in two stages, namely pretest and posttest. The test instrument used in this study was the vertical jump test in the Indonesian Physical Fitness Test (TKJI) found in the book Physical Education Theory and Practice by Permana (2020). The purpose of this test was to determine students' leg muscle strength before and after treatment. With this instrument, the study can obtain accurate, measurable data, thereby providing a strong scientific basis for the research results.

The implementation of the Vertical Jump Test as described by Permana (2020). is as follows:

a. Starting Position

1) First, coat the participant's fingertips with chalk/magnesium carbonate powder.

2) The participant stands upright near the wall with feet together, the scale board on the right or left side of the participant's body.

3) The hand closest to the wall is raised straight up, with the palm pressed against the measuring board to leave a vertical fingerprint mark.

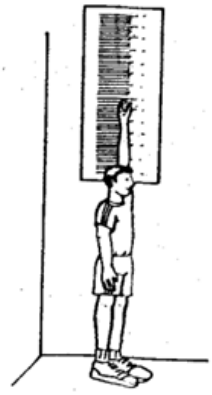

Figure 1. Attitude Determines Achievement
(Source: Nurhasanah in Permana's book (2020))

The image above shows the participants' starting position before jumping, standing upright with their hands raised to determine their vertical reach as a reference.

b. Movement

1) Participants begin by bending their knees and swinging both arms backward.

2) Participants jump as high as possible while clapping the board with their closest hand, leaving a finger mark.

3) The test is performed three times, either consecutively without rest or interspersed with other participants.

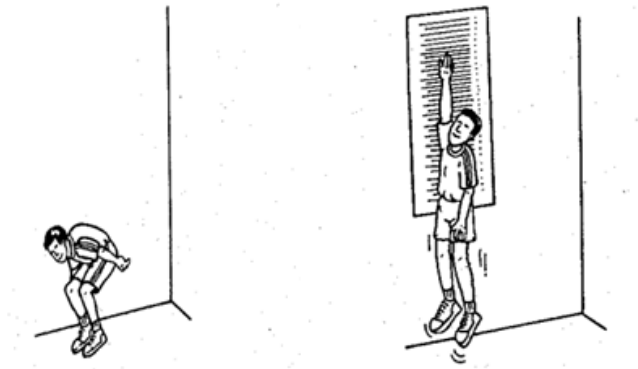

Figure 2. Performing Vertical Jumps
(Source: Permana (2020))

The image above shows the core movement of the vertical jump test, which is pushing off with the feet and swinging the arms to achieve maximum jump height and leave finger marks on the scale board.

c. Recording Results

1) Jump results are recorded based on the difference between the jump height and the standing height.

2) The three difference results are recorded in sequence.

3) The value used is the largest difference of the three attempts.

After the vertical jump test is conducted, the students' jump results are recorded based on the difference between the jump height and the standing height. To facilitate interpretation, the scores obtained are then converted into assessment categories according to the Indonesian Physical Fitness Test (TKJI) standards. These categories distinguish the level of leg muscle strength of students based on the scores achieved, as shown in the following table:

Table 1. Rubrics for leg muscle strength

Boys	Girls	Score	Category
46 and above	42 and above	5	Very Good
38–45	34–41	4	Good
31–37	28–33	3	Moderate
24–30	21–27	2	Poor
23 and below	20 and below	1	Very Poor

The table above shows the classification of vertical jump test results based on the scores achieved by male and female students. Higher scores reflect better leg muscle strength. The Excellent category is given to male students with scores ≥ 46 and female students with scores ≥ 42, indicating optimal leg muscle strength. The Good category is in the score range of 38–45 for males and 34–41 for females, indicating fairly good leg muscle strength. The Average category (31–37 for boys; 28–33 for girls) indicates average leg muscle strength, while the Poor category (24–30 for boys; 21–27 for girls) indicates low leg muscle strength. Scores ≤ 23 for males and ≤ 20 for females fall into the Very Low category, indicating the need for additional training to improve leg muscle strength.

Prior to implementation, the instrument was first tested for validity and reliability. The validity and reliability of the instrument refer to the test results for TKJI. The research by Huda et al. (2024) also confirms that TKJI has high reliability, as evidenced by test-retest reliability in elementary school students ($r = 0.82$). The use of this national standard instrument aims to improve the consistency and credibility of measurement results in research.

The indicator of leg muscle strength in this study was assessed through vertical jump results, which measured how high students could jump from a standing position. The higher the jump, the greater the leg muscle strength. Thus, the main indicator was the height of the jump as a measure of leg muscle explosive power (Permana, 2020).

2. Observation

Observations were conducted during the learning process to monitor student engagement and the implementation of the jump rope game. The observations were non-participatory, in which the researcher only recorded the activities without participating in the learning process.

3. Interviews

Semi-structured interviews were conducted with physical education and homeroom teachers to gather additional information on student characteristics, responses to learning, and obstacles encountered during the study.

B. Research Procedure

The research procedure was carried out through several systematic stages. First, a pretest was conducted on both the experimental and control groups to measure students' initial leg muscle strength. The pretest was conducted using a vertical jump test with the same testing conditions for both groups to ensure measurement consistency.

Second, the treatment phase was conducted over six learning sessions, excluding the pretest and posttest. The experimental group received PJOK lessons using the traditional game of jumping rope, while the control group received conventional PJOK lessons without integrating traditional games. Each session was carried out in accordance with the prepared lesson plan, so that the treatment of the experimental group was consistent and the delivery of lessons to the control group remained uniform.

After all treatment sessions were completed, a posttest was conducted on both groups using the same instrument as the pretest, namely the vertical jump test, to measure the strength of the students' lower leg muscles. A comparison of pretest and posttest scores was used to determine the effect of the traditional jump rope game on students' lower leg muscle strength.

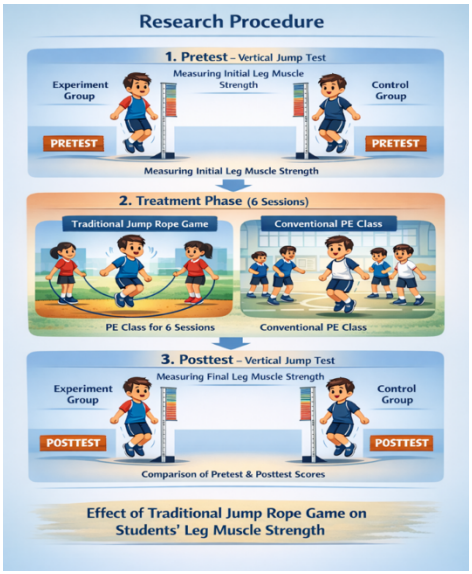

Figure 3. Research Procedure

C. Data Analysis

The pretest and posttest data were analyzed using descriptive and inferential statistics. Descriptive statistics used included the mean, standard deviation, minimum, and maximum to describe the leg muscle strength of students in the experimental and control groups. Data were obtained from the Vertical Jump Test conducted before and after the treatment.

Prior to hypothesis testing, prerequisite tests were conducted. Normality was tested using the Shapiro–Wilk test because the sample size was less than 50 participants. In addition, homogeneity of variance was tested using Levene's test to determine the similarity of variance between the experimental and control groups. The data were declared to be normally distributed and homogeneous if the significance value was greater than 0.05 ($p > 0.05$).

If the normality test results show that the data are not normally distributed ($p < 0.05$), the analysis is continued using nonparametric tests. In this study, the Mann–Whitney U test was used to assess differences in leg muscle strength between the experimental and control groups. This test was used because the data came from two independent groups.

The significance level used was $\alpha = 0.05$. If the significance value was less than 0.05 ($p < 0.05$), there was a significant difference between the experimental and control groups, indicating that the traditional jump rope game affected students' leg muscle strength.

FINDINGS AND DISCUSSION

Findings

A. Descriptive Statistics

Descriptive statistics provide an initial overview of the data before inferential analysis is performed. The minimum, maximum, mean, and standard deviation values are displayed to show trends in the pretest and posttest results for both the experimental and control groups. Thus, descriptive statistics form the basis for recognizing general patterns and preparing for hypothesis testing.

1. Descriptive Statistics for the Experimental Class

Tabel 2. Descriptive Statistics for the Experimental Class

	Descriptive Statistics				
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Pretest Eksperiment	23	1	4	2.57	1.161
Posttest Eksperiment	23	2	5	3.26	0.810
Valid N (listwise)	23				

Source: SPSS 29

Descriptive statistics for the experimental group show that before treatment (pretest), students' leg muscle strength scores ranged from 1 to 4, with an average of 2.57 and a standard

deviation of 1.161, indicating initial abilities ranging from low to moderate. After the treatment (posttest), the scores ranged from 2–5, with an average of 3.26 and a standard deviation of 0.810, indicating an increase in leg muscle strength and more homogeneous results among students. Therefore, it can be concluded that treatment through jump rope games had a positive impact on test results.

2. Descriptive Statistics for the Control Class

Table 3. Descriptive Statistics for the Control Class

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Pretest_Control	24	1	5	2.67	1.007
Posttest Control	24	1	4	2.67	0.816
Valid N (listwise)	24				

Source: SPSS 29

Descriptive statistics for the control group show that before treatment (pretest), students' leg muscle strength scores ranged from 1 to 5, with an average of 2.67 and a standard deviation of 1.007, while after treatment (posttest), scores ranged from 1 to 4, with an average of 2.67 and a standard deviation of 0.816. these results indicate that there was no change in the average leg muscle strength in the control group.

B. Prerequisite Tests

In this study, before conducting the analysis using the Mann–Whitney test, a prerequisite normality and homogeneity test was conducted to ensure that the data met the analysis requirements and could be used appropriately in hypothesis testing.

1. Normality Test

The purpose of the normality test is to determine whether the research data are normally distributed, so that the appropriate statistical analysis can be selected for hypothesis testing.

Tabel. 4 Normality Test

Tests of Normality			
	Shapiro-Wilk		
	Statistic	**df**	**Sig.**
Pretest_Eks	.869	23	.006
Posttest_Eks	.867	23	.006
Pretest_Control	.846	24	.002
Posttest_Control	.857	24	.004

Based on the results of the normality test using the Shapiro–Wilk method as shown in the table above, the significance value (Sig.) for all pretest and posttest data in both the experimental

and control classes was below the significance level of 0.05. The significance value for the pretest in the experimental class was 0.006 and for the posttest in the experimental class was 0.006. Meanwhile, the significance value for the pretest in the control class was 0.002 and for the posttest in the control class was 0.004.

The results show that all data, both pretest and posttest in the experimental class and control class, are not normally distributed, because the Sig. value is < 0.05. Thus, the research data does not meet the assumption of normality, so the next hypothesis testing uses an appropriate nonparametric statistical test.

2. Homogeneity Test

The purpose of the homogeneity test is to ensure that the variance of data between research groups is the same or homogeneous, so that group comparisons can be made fairly and the statistical analysis used (e.g., parametric and non-parametric tests) becomes more valid.

Tabel. 5 Homogeneity Test

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
Pretest Eks_Control	Based on Mean	.450	1	45	.506
	Based on Median	.504	1	45	.481
	Based on Median and with adjusted df	.504	1	44.263	.481
	Based on trimmed mean	.350	1	45	.557
Posttest Eks_Control	Based on Mean	.000	1	45	.992
	Based on Median	.020	1	45	.889
	Based on Median and with adjusted df	.020	1	44.424	.889
	Based on trimmed mean	.000	1	45	.995

Source: SPSS 29

Based on the results of the Levene's test for homogeneity of variance, the significance value (Sig.) in the pretest data between the experimental and control classes was 0.506 (mean), and in the posttest data was 0.992, both of which were greater than the significance level of 0.05; this indicates that the variance of the pretest and posttest data was homogeneous. However, the Mann-Whitney U nonparametric test was still used to test the hypothesis because the normality test results were not normally distributed.

3. Mann Whitney U Test

The purpose of the Mann-Whitney U test is to determine whether there is a significant

difference between two independent groups in data that is not normally distributed or does not meet parametric assumptions. This test is used as an alternative to the Independent Samples t-test to compare the medians or distributions of the two groups more accurately when the normality assumption is not met.

Table 6. Mann-Whitney U Test

Test Statistics[a]	
	Posttest Eks_Control
Mann-Whitney U	176.000
Z	-2.279
Asymp. Sig. (2-tailed)	.023

Source: SPSS 29

Based on the results of the Mann–Whitney U test on the posttest leg muscle strength scores between the experimental class and the control class, a Mann–Whitney U value of 176.000 was obtained with a Z value of −2.279. The Asymp. Sig. (2-tailed) significance value was 0.023, which was smaller than the significance level of 0.05. These results indicate a significant difference in posttest leg muscle strength between students in the experimental and control classes.

C. Contextual Interpretation

Contextual interpretation of the research results shows that jump rope intervention has a greater effect on improving leg muscle strength than conventional physical education. The improvement in the experimental group was not only greater, but also more consistent, as reflected in the lower standard deviation value. This confirms that structured activities based on traditional games, such as jump rope, can create a more effective learning experience for elementary school students. These findings align with motor learning theory, which emphasizes specific, goal-oriented practice, and support the principles of physical education by making the learning process more meaningful and engaging.

Discussion

The findings of this study indicate that traditional jump rope intervention has a significant effect on improving students' leg muscle strength compared to conventional physical education learning. The experimental group showed higher posttest scores and lower standard deviations, indicating more consistent training outcomes among students. This condition indicates that game-based physical activities can provide more effective training stimuli than routine and less varied learning. Repeated jumping movements in jump rope games provide natural training loads that

stimulate gradual leg muscle adaptation. This activity also creates a fun learning atmosphere, encouraging students to be actively involved in the learning process. The high level of participation contributes to increased learning motivation and consistency in students' physical activity. Thus, the traditional game of jump rope can be seen as an effective PJOK learning strategy for increasing leg muscle strength among elementary school students.

The increase in leg muscle strength achieved by students can be explained through cognitive development theory, which emphasizes the importance of direct learning experiences. According to Piaget's cognitive development theory, elementary school-aged children are in the concrete operational stage, where understanding is formed through active interaction with the environment and real activities (Leny Marinda, 2020). Jump rope games provide concrete motor experiences that allow students to understand the concept of movement through direct practice, not just verbal instructions. The process of repeating jumping movements is also in line with the principles of physical exercise in the form of overload and repetition, which encourage neuromuscular adaptation and increased muscle strength. A meta-analysis by Singh et al. (2022) shows that jump rope training significantly improves children's physical fitness, including leg muscle strength and explosive power. In addition, Zhao et al. (2023) explain that jump-rope activities grounded in direct experience can improve the physical abilities of 10-12-year-old children through active, contextual learning. Therefore, the results of this study reinforce that integrating play activities with physical exercise principles and child development learning theory can produce optimal improvements in physical abilities.

The results of this study align with previous studies demonstrating the effectiveness of jump rope activities on the physical development of elementary school children. Cant et al. (2023) found that jump rope training improved students' leg muscle strength and balance, supporting the findings of improved physical abilities in this study. Chen et al. (2026) also stated that coordination-based games can significantly improve fundamental movement skills through repetitive movement activities. Research by Suirah, Ayu Fajarwati (2024), showed that traditional jump rope games are effective in improving children's gross motor skills and balance. These findings are reinforced by Barus et al. (2026), who emphasize that jump rope activities develop motor skills through a combination of strength, coordination, and movement control. In addition, Saputra et al. (2024) and Lin (2022) emphasize that structured physical activities play an important role in improving children's locomotor abilities. The results of studies by Rizki Pebrian et al. (2022), Ramayanti et al.

(2025), and Yani & Domitilla (2020), also confirm that jump rope training provides effective neuromuscular stimulation in improving the leg muscle strength of elementary school students.

In practical terms, the results of this study make an important contribution to the implementation of physical education in elementary schools. The traditional game of jump rope can serve as a simple, economical, and easy-to-implement learning strategy for teachers across various school settings. This activity does not require complex facilities but can still provide optimal physical exercise for students. Repeated jumping movements serve as aerobic exercise, stimulating continuous contraction of the lower extremity muscles. Cahyani et al. (2024) explain that jump rope exercise can improve physical function through muscle adaptation due to structured jumping activities. In addition to increasing leg muscle strength, this game also encourages social interaction, cooperation, and student confidence during learning. Therefore, integrating traditional games into PJOK learning can support students' overall physical and socio-emotional development.

Although it shows positive results, this study has several limitations that should be considered when interpreting the findings. The study was conducted at only one school with a relatively small sample size, limiting the generalizability of the research results. Variations in student characteristics and differences in learning environments were not fully accommodated in this study. In addition, the study focused only on leg muscle strength without measuring other components of physical fitness such as agility, coordination, and cardiorespiratory endurance. The relatively short duration of the intervention meant that the long-term effects of the training were not fully apparent. External factors such as students' physical activity outside of school could not be fully controlled during the study. Therefore, the results of this study should be considered preliminary and require further testing.

Given these limitations, further research should involve a larger sample and draw from multiple schools to increase the generalizability of the results. Further research could also examine the effect of jump rope games on other motor components such as agility, dynamic balance, coordination, and physical endurance of students. A longitudinal research design is necessary to determine the long-term effectiveness of jump rope exercises on children's physical fitness development. Subsequent researchers can also compare various types of traditional games to find the most effective PJOK learning model. The integration of digital technology or interactive media in game-based learning can be an innovation for future research. More extensive research and development are expected to strengthen the position of traditional games as an adaptive,

sustainable, activity-based PJOK learning model. Thus, further research can make a more comprehensive contribution to the development of physical education learning in elementary schools.

Further research is recommended to expand the scope by involving more schools and larger samples. In addition, further studies can explore the influence of jump rope games on other motor skills and affective aspects such as motivation, involvement, and sportsmanship. Thus, a more comprehensive understanding of the pedagogical value of traditional games in PJOK can be obtained.

In conclusion, jump rope games offer pedagogical and theoretical contributions. Pedagogically, this game offers an innovative learning model that physical education teachers can apply to improve leg muscle strength while preserving local cultural values. Theoretically, this study reinforces the motor learning framework by showing that structured, goal-oriented traditional game-based activities consistently promote improvements in students' physical skills.

CONCLUSION

This study confirms that the traditional game of jump rope, as a structured, goal-oriented activity, plays a significant role in improving leg muscle strength among elementary school students. The main contribution of this study is to provide an innovative, applicable, and evidence-based learning model that enriches Physical Education, Sports, and Health (PJOK) practices while strengthening Piaget's cognitive development theory. Thus, this study provides a theoretical and practical foundation for developing more meaningful learning strategies aligned with students' developmental characteristics.

Practically speaking, these findings imply that physical education teachers can integrate jump rope games as an alternative approach to improving leg muscle strength while creating a more enjoyable and participatory learning environment. However, this study has limitations, including a relatively small sample size and a limited focus on leg muscle strength, so the generalizability of the results still needs to be further tested.

Further research is recommended to expand the scope by involving larger samples and different school contexts, and to explore the influence of jump rope games on other motor skills, such as agility, coordination, and endurance, as well as affective aspects such as motivation and sportsmanship. These efforts will further validate the effectiveness of traditional games as a game-

based learning strategy in improving the quality of physical education in elementary schools.

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