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The Effect of Traditional Game-Based Physical Activity on Cardiovascular Endurance of Elementary School Students

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Abstract

This research aimed to examine the effect of traditional game-based physical activity on cardiovascular endurance in Physical Education, Sports, and Health (PJOK) learning among fifth-grade elementary school students. The activities were implemented through traditional games (*boy-boyan*, *gobak sodor*, *lari balok*, and *ucing-ucingan*) designed to involve dynamic movements in a structured and progressive manner. This research employed a quasi-experimental method with a nonequivalent control group design. The participants consisted of 52 fifth-grade students at SD Negeri Sambongpari, divided into an experimental group (n = 26) and a control group (n = 26). The experimental group received traditional game-based instruction, while the control group followed conventional PJOK instruction. Data were collected using the Foster Test to measure cardiovascular endurance and were analyzed using descriptive statistics and the Mann–Whitney U test at a significance level of 0.05. The results indicated differences between pretest and posttest scores in both groups, with a greater mean difference in the experimental group improved from 4.23 to 9.15, whereas the control group increased from 4.38 to 5.73. Statistical analysis revealed a significant difference between the posttest results of the two groups ($Z = -3.777$; $p < 0.001$). These findings indicate that traditional game-based activities can serve as an effective pedagogical strategy in physical education to improve students' cardiovascular fitness.

Keywords Cardiovascular Endurance, Physical Activity, Traditional Games.

INTRODUCTION

Physical inactivity among children has become a global concern, as low levels of physical activity are associated with increased risks of obesity and non-communicable diseases from an early age (WHO, 2023). Around 81% of adolescents between the ages of 11 and 17 fail to meet the recommended 60 minutes of daily moderate-to-vigorous physical activity, thereby elevating the risk of obesity and cardiovascular disease throughout the lifespan. This sedentary behavior frequently continues into adulthood and is linked to chronic diseases, including type 2 diabetes and hypertension (Goyal & Rakhra, 2024). In addition, scientific evidence indicates that physical inactivity is a modifiable cardiovascular risk factor, whereas regular physical activity provides protective effects by improving cardiometabolic profiles and overall cardiovascular health (Bucciarelli et al., 2023). Cardiovascular endurance, defined as the ability of the heart and lungs to continuously supply oxygen during sustained physical activity (Mukti *et al*., 2024), is a key indicator of physical fitness and plays a crucial role in supporting children's participation in daily learning activities. In the educational context, insufficient cardiovascular endurance may reduce students' readiness to engage in prolonged movement tasks, as children tend to experience fatigue more quickly.

At the national level, similar concerns are evident in Indonesia. Health reports indicate that the cardiovascular endurance of elementary school students remains below the expected standard for children aged 10–12 years (Kemenkes, 2022). Ideally, Physical Education, Sports, and Health (PJOK) learning should function as education through and about physical activity, where meaningful movement experiences become the core of the pedagogical process (Mustafa & Dwiyogo, 2020; Samsudin, 2020). However, the persistence of low fitness levels suggests a gap between PJOK's objectives for developing physical fitness and the actual outcomes achieved among students.

This condition is also reflected at the local level, particularly at SD Negeri Sambongpari. Initial observations and interviews conducted in October 2025 revealed that PJOK instruction was still dominated by routine exercises such as morning gymnastics, running drills, and simple throwing and catching activities. The PJOK teacher reported that several students fatigued quickly and were unable to maintain high-intensity movement for extended periods. Furthermore, assessment practices primarily relied on simple running completion times and had not utilized objective instruments such as the Foster Test. Fitness data from the 2023/2024 academic year showed

that approximately 61.54% of fifth-grade students were categorized as having low physical fitness, including cardiovascular endurance. These findings indicate the urgency of implementing more structured and engaging learning strategies to improve students' cardiovascular endurance.

Previous research has demonstrated that traditional games contribute positively to students' physical fitness. Fauzi et al. (2023) reported a 59.3% improvement in general physical fitness using the TKJI test, while Surur et al. (2024) identified significant differences between experimental and control groups receiving traditional game interventions ($p < 0.05$). Latif et al. (2024) further highlighted that the traditional sport lari balok improved children's motor abilities, particularly endurance, coordination, and balance. However, most prior research has focused on overall physical fitness or specific motor aspects without explicitly examining cardiovascular endurance using objective and practical measurement instruments applicable in elementary school contexts. This reveals a research gap regarding the specific impact of structured traditional game-based physical activity on cardiovascular endurance measured through standardized tools such as the Foster Test.

To address this gap, the present research introduces a structured and progressively implemented traditional game-based physical activity program consisting of *boy-boyan*, *gobak sodor*, *lari balok*, and *ucing-ucingan*. The primary independent variable is traditional game-based physical activity, while the dependent variable is cardiovascular endurance. Physical activity is defined as any bodily movement produced by skeletal muscles that increases energy expenditure above resting levels (Suherman, 2018; Panjaitan, 2020). Within this framework, traditional games are positioned as structured physical activity stimuli designed to elicit cardiovascular responses (Suherman, 2018; Panjaitan, 2020). These traditional games involve dynamic and repetitive aerobic movements such as running, dodging, chasing, and rapid directional changes, which are known to stimulate cardiovascular adaptation (Handoko & Gumantan, 2021; Siswanto *et al*., 2022). Unlike previous research, this study integrates four traditional games within a quasi-experimental nonequivalent control group design and specifically measures cardiovascular endurance using the Foster Test. Thus, the novelty of this research lies in its structured progressive intervention design and its focused measurement of cardiovascular endurance as a distinct fitness component in elementary school settings.

Traditional games are understood as play activities that develop within communities and are passed down through generations, encompassing cultural values and elements of movement and social interaction. Traditional games not only provide enjoyment but also embody values of

cooperation, sportsmanship, discipline, and togetherness (Wahyuni *et al*., 2023; Yusup *et al*., 2023:). From a physical education perspective, traditional games are considered relevant because they involve dynamic movements such as running, jumping, dodging, and chasing, which can stimulate students' physical fitness. Amid technological advancement and increasing sedentary behavior, traditional games can serve as an alternative to reduce children's dependence on gadgets while encouraging greater physical activity (Priadana *et al*., 2025).

The traditional games used in this research consist of four types: *boy-boyan*, *gobak sodor*, *lari balok*, and *ucing-ucingan*. *Boy-boyan* is a group game involving at least five children, in which one team rebuilds fragments of bricks into a pyramid while the opposing team attempts to prevent them, thereby fostering cooperation and social interaction (Aisyah, 2020). *Gobak sodor* is a two-team game in which attacking players attempt to pass through guarded lines without being touched by defenders, involving rapid running, changes of direction, and team strategy (Ningtyas *et al*., 2024). *Lari balok* is a game requiring players to move forward by stepping on wooden blocks, demanding balance, coordination, and movement rhythm, while continuously stimulating cardiovascular activity (Rizqa *et al*. 2023; Latif *et al*., 2024). *Ucing-ucingan* is a traditional chasing game in which one player acts as the chaser (*ucing*) while others attempt to evade (Harini & Zenab, 2023). Therefore, this study aims to examine the effect of traditional game-based physical activity on the cardiovascular endurance of fifth-grade elementary school students.

METHOD

The research method constitutes a series of steps undertaken by the researcher to collect and analyze data in order to obtain an understanding aligned with the research objectives (Ramadhani *et al*., 2023). This research employed a quantitative approach using a quasi-experimental method. The design applied was the Nonequivalent Control Group Design, involving two groups (an experimental group and a control group) selected without random assignment (Creswell, 2023). Both groups were administered a pretest to determine their initial level of cardiovascular endurance. The experimental group then received treatment in the form of structured traditional game-based physical activity, while the control group participated in conventional PJOK instruction. After the intervention period, both groups were administered a posttest to identify changes in cardiovascular endurance.

The population consisted of all fifth-grade students of SD Negeri Sambongpari, totaling 52 students. Due to the relatively small population size, this research employed a total sampling technique, in which all members of the population were included as research participants. Total sampling was selected to ensure full representation of the population and to avoid sampling bias. The participants were divided into two existing classes: 26 students in the experimental group and 26 students in the control group. The study was conducted during the second semester of the 2025/2026 academic year on January 13, 20, 23, 27, and 30, and February 3, 2026.

The intervention in the experimental group was implemented over six sessions, each lasting 140 minutes, consisting of introduction, warm-up, core activities, and closing. The traditional games applied included *boy-boyan*, *gobak sodor*, *lari balok*, and *ucing-ucingan*. The intensity of the activities was progressively increased from one set in the initial sessions to three sets in the final sessions. Meanwhile, the control group received conventional PJOK instruction without structured traditional game implementation.

Data were collected through the Foster Test, observation, interviews, and documentation. The instrument used to measure cardiovascular endurance was the Foster Test, a fitness test designed to assess pulse rate responses before activity, immediately after activity, and after the recovery period (Permana, 2024). Observation was conducted to directly monitor the implementation of traditional game-based physical activity and the development of students' cardiovascular endurance throughout the study. In addition, unstructured interviews were conducted to complement the observational data and to obtain a more comprehensive understanding of the learning process at the school. The final score was calculated based on the difference in pulse rate according to established physical fitness classification guidelines. Documentation in the form of photographs, field notes, and test results was used as supporting data.

In this research, the Foster Test instrument had established validity, as it was developed based on standardized physical fitness assessment guidelines. The researcher also ensured instrument reliability through a simple reliability procedure. A test–retest procedure was conducted by administering the Foster Test to a small sample of students (1–3 students), followed by a repeated test after a 30-minute interval.

Data analysis was performed using SPSS 27. Descriptive statistics were first calculated to summarize pretest and posttest results. To ensure baseline comparability between groups, pretest scores of the experimental and control groups were analyzed. Since the normality test using

Shapiro–Wilk indicated that the data were not normally distributed, a nonparametric Mann–Whitney U test was conducted to compare pretest scores between groups. The analysis showed no statistically significant difference in pretest scores ($p > 0.05$), indicating that both groups had comparable initial cardiovascular endurance levels prior to the intervention.

Subsequently, assumption testing was conducted using the Shapiro–Wilk test for normality and Levene's test for homogeneity. As the data were not normally distributed, hypothesis testing was conducted using the nonparametric Mann–Whitney U test to analyze differences in posttest results between the independent experimental and control groups at a significance level of 0.05.

FINDINGS AND DISCUSSION

Findings

A. Descriptive Statistics

Prior to conducting assumption testing and hypothesis analysis, descriptive statistics were calculated to provide an overview of students' cardiovascular endurance scores in both the experimental and control groups. The descriptive analysis includes the mean (M) and standard deviation (SD) of pretest and posttest scores, as presented in Table 1:

Table 1. Descriptive Statistics of Foster Test Scores

Group	Pretest (Mean ± Std. Deviation)	Posttest (Mean ± Std. Deviation)
Experimental	4.23 ± 2.438	9.15 ± 2.344
Control	4.38 ± 3.021	5.73 ± 3.106
N	26	

Source: Output SPSS 27

As shown in Table 1, the experimental group obtained a pretest mean score of 4.23 (SD = 2.438), while the control group obtained a pretest mean score of 4.38 (SD = 3.021). These findings indicate that both groups had relatively comparable initial levels of cardiovascular endurance prior to the intervention.

Following the intervention, the experimental group demonstrated a substantial increase, with a posttest mean score of 9.15 (SD = 2.344). In contrast, the control group showed a smaller improvement, with a posttest mean score of 5.73 (SD = 3.106). Descriptively, the increase in the experimental group appears considerably greater than that of the control group. However, further statistical testing was conducted to determine whether these differences were statistically significant.

B. Classical Assumption Test

The classical assumption test was conducted to ensure that the data analyzed met the fundamental requirements of statistical analysis so that the conclusions drawn could be scientifically justified (Wulandari & Widiyono, 2025). In this research, the assumption testing included tests of normality and homogeneity.

1. Normality Test

The normality test was conducted to determine whether the research data were normally distributed. In this study, normality was tested using the Shapiro–Wilk test, as the sample size in each group was fewer than 50 respondents. Data processing was carried out using SPSS 27, and the results of the normality test are presented in the following table:

Table 2. Results of the Shapiro–Wilk Normality Test

	Test of Normality					
	Kolmogrov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest_Experimental	.205	26	.007	.912	26	.029
Posttest_ Experimental	.102	26	.200	.976	26	.779
Pretest_Control	.166	26	.063	.899	26	.015
Posttest_Control	.134	26	.200	.923	26	.053

Source: Output SPSS 27

Based on the results of the normality test presented in Table 3, the pretest data for the experimental class showed a p-value of 0.029 (< 0.05), indicating that the pretest data were not normally distributed. Meanwhile, the posttest data for the experimental class yielded a p-value of 0.779 (p > 0.05), indicating that the data were normally distributed. In the control class, the Shapiro–Wilk test indicated that the pretest data had a p-value of 0.015 (p < 0.05), indicating that the pretest data were not normally distributed. The posttest data for the control class had a p-value of 0.053 (p > 0.05), indicating that the data were normally distributed. Since not all data were normally distributed, the hypothesis testing was conducted using nonparametric tests.

2. Homogeneity Test

The homogeneity test was conducted to determine whether the variance of students' learning outcomes in the experimental class, which received traditional game-based physical activities (*boy-boyan*, *gobak sodor*, *lari balok*, and *ucing-ucingan*), and the control class, which received conventional instruction, was equal. The homogeneity test was analyzed using SPSS 27 through Levene's test. The decision criteria for this test were as follows: if the significance value (Sig.) was greater than 0.05, the data were considered homogeneous; if the significance value (Sig.) was less than 0.05, the data were

considered not homogeneous. The results of the homogeneity test are presented in the following table:

Table 3. Results of the Homogeneity Test

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
Pretest Experimental_Control	Based on Mean	.471	1	50	.496
	Based on Median	.263	1	50	.610
	Based on Median and with adjusted df	.263	1	42.384	.610
	Based on trimmed mean	.321	1	50	.573
Posttest Experimental_Control	Based on Mean	2.894	1	50	.095
	Based on Median	2.911	1	50	.094
	Based on Median and with adjusted df	2.911	1	48.570	.094
	Based on trimmed mean	2.892	1	50	.095

Source: Output SPSS 27

Based on the results of the homogeneity test presented in Table 4, the pretest data for the experimental and control classes yielded a p-value of 0.496. This value is greater than 0.05 (Sig. > 0.05), indicating that the pretest data variances in both classes are homogeneous. Furthermore, the posttest data for the experimental and control classes yielded a significance value of 0.095 based on the mean. This value is also greater than 0.05 (Sig. > 0.05), indicating that the posttest variances between the experimental and control classes are homogeneous. Therefore, both the pretest and posttest data in the two classes meet the assumption of homogeneity of variance.

C. Hypothesis

The results of the normality test indicated that the data were not normally distributed. Therefore, hypothesis testing in this research was conducted using a nonparametric statistical test. Since the objective of this research was to compare cardiovascular endurance outcomes between two independent groups (experimental and control), the Mann–Whitney U test was selected as the appropriate analytical method.

The proposed hypothesis stated that "there is a significant effect of traditional game-based physical activity on the cardiovascular endurance of fifth-grade students at SD Negeri Sambongpari". Hypothesis testing was conducted by comparing the posttest scores of the experimental and control groups. The decision-making criteria were based on the significance value: if the significance value was less than 0.05, H_0 was rejected and H_a was accepted. If the significance value was greater than 0.05, H_0 was accepted and H_a was rejected. The results of the Mann–Whitney U test analysis using SPSS 27 are presented in the following table:

Table 4. Results of the Mann-Whitney U Test

Test Statistics	Posttest_Experimental_Control
Mann-Whitney U	132.500
Wilcoxon W	483.500
Z	-3.777
Asymp. Sig (2-tailed)	< ,001

Source: Output SPSS 27

Based on the results of the Mann–Whitney U test presented in Table 6, which was conducted to compare the posttest scores between the experimental and control classes, the Mann–Whitney U value was 132,500 and the Wilcoxon W value was 483,500. In addition, the Z value obtained was -3.777. The resulting Asymp. Sig. (2-tailed) value was less than 0.001 ($p < 0.05$). Since this significance value is lower than the established significance level of 0.05, it can be concluded that there is a statistically significant difference between the posttest results of the experimental and control classes. Therefore, the null hypothesis (H_0) is rejected and the alternative hypothesis (H_a) is accepted. This finding indicates that the treatment administered to the experimental class had a significant effect compared to the control class.

Discussion

Based on the statistical analysis, the implementation of structured traditional game-based physical activity produced a statistically significant difference in cardiovascular endurance between the experimental and control groups. The experimental group demonstrated a substantial increase in mean Foster Test scores from 4.23 to 9.15 (116.31%), whereas the control group showed a comparatively smaller increase from 4.38 to 5.73 (30.82%). The Mann–Whitney U test confirmed that this difference was statistically significant ($Z = -3.777$; $p < .001$), indicating that the observed effect was unlikely to have occurred by chance. These results provide empirical evidence that the intervention generated a meaningful improvement in cardiovascular endurance beyond the effects of conventional PJOK instruction.

The considerably greater magnitude of improvement in the experimental group suggests that the traditional games, when systematically organized and progressively intensified, functioned as an effective aerobic training stimulus. The structured increase in activity sets likely enhanced cardiovascular workload in a gradual manner, enabling physiological adaptation to occur. In contrast, the more modest gains observed in the control group may reflect the absence of structured intensity progression and limited variability in movement patterns. The dynamic characteristics of the traditional games—such as repeated running, rapid directional changes, chasing, and dodging—

appear to have promoted sustained moderate-to-vigorous physical activity, which is essential for improving cardiorespiratory endurance.

Additionally, the marked disparity between groups implies that engagement and contextual enjoyment may have contributed to maintaining activity intensity throughout the sessions. Higher student involvement potentially reduced passive time and increased overall energy expenditure, thereby reinforcing the physiological stimulus required for cardiovascular adaptation. Collectively, these findings indicate that the effectiveness of traditional game-based physical activity lies not only in the type of movements performed but also in the structured progression and sustained engagement embedded within the intervention design.

These findings align with Fauzi et al. (2023), who reported significant improvements in physical fitness through traditional games. However, unlike previous studies that assessed general fitness using TKJI, this study specifically measured cardiovascular endurance using the Foster Test, providing more focused physiological evidence. Similarly, Surur et al. (2024) found significant differences between experimental and control groups in game-based interventions. Latif et al. (2024) also demonstrated improvements in endurance and coordination through *lari balok*.

International evidence supports these results. Poitras et al. (2016) concluded that moderate-to-vigorous physical activity is positively associated with cardiovascular fitness in children. Ortega et al. (2018) emphasized that cardiorespiratory fitness is a strong predictor of health outcomes in youth. Moreover, Lubans et al. (2016) highlighted that engaging, structured physical activity programs enhance both physiological and cognitive outcomes in school-aged children. Thus, this study strengthens existing literature by integrating culturally relevant traditional games within a progressive training framework.

These findings can also be interpreted conceptually through the theoretical framework employed. In relation to Motor Learning Theory proposed by Richard A. Schmidt (1975), the difference in cardiovascular endurance outcomes in the experimental class can be explained by the formation and strengthening of motor schemas. Motor learning occurs through repeated practice and varied movement experiences. In this research, students' engagement in diverse traditional games required continuous motor adjustments, resulting in increasingly organized and efficient movement patterns. This perspective is reinforced by Chua *et al*. (2019) who demonstrated that practice variability leads to superior motor skill learning compared to constant practice, as movement variation facilitates the development and reinforcement of motor schemas across

different contexts.

In *boy-boyan*, *gobak sodor*, *lari balok*, and *ucing-ucingan*, students performed repeated and varied movements such as running, dodging, chasing, throwing, and rapid changes of direction. Each movement experience provided sensory and motor feedback stored in memory. Through consistent repetition over six sessions, initially unstable movement patterns became more organized and efficient. This efficiency contributed to more controlled energy expenditure, enabling students to sustain physical activity for longer durations without rapid fatigue.

Furthermore, these findings can be explained through the concept of General Adaptation Syndrome (GAS) introduced by Hans Selye and further developed in training periodization theory by Bompa and Buzziechelli (2019), which emphasizes physiological adaptation to training loads. The gradual increase in intensity (from one set in the initial session to three sets in the final session) reflects the principle of progressive overload. Initially, students' bodies responded in the alarm phase, characterized by fatigue as an early physiological response. However, due to the structured and progressive stimulus, the body adapted in the resistance phase rather than entering exhaustion. This adaptation enhanced cardiovascular capacity, including improved cardiac and pulmonary efficiency in oxygen distribution. Such adaptation was reflected in the differences in Foster Test results in the experimental class posttest. From a motor perspective, students strengthened their motor schemas through repeated practice; physiologically, their bodies adapted to progressively increasing training loads, resulting in significantly better cardiovascular endurance.

The findings suggest that traditional games can function as structured aerobic training when systematically planned and progressively intensified. For physical education teachers, this indicates that culturally embedded activities can be redesigned as fitness-oriented instructional strategies rather than merely recreational play. Integrating traditional games into PJOK instruction may therefore support physiological adaptation while simultaneously increasing student participation and engagement in elementary school settings.

Despite the significant findings, several methodological limitations should be acknowledged. The use of a nonequivalent control group design without random assignment may have introduced selection bias, as baseline differences and unmeasured confounding variables cannot be entirely ruled out in non-randomized studies (Sterne et al., 2016). Although pretest analysis indicated relatively comparable initial means between groups, factors such as prior physical activity habits, extracurricular participation, or individual health conditions may have influenced

the observed outcomes beyond the intervention itself.

In addition, the possibility of a Hawthorne effect, also known as research participation effects, cannot be ruled out. This phenomenon describes behavioral changes that occur because participants are aware that they are being observed or involved in a study, rather than solely due to the intervention itself (Berkhout et al., 2022). Such effects have been reported in quasi-experimental designs, where increased attention and novelty may temporarily enhance motivation and performance. Therefore, part of the improvement observed in the experimental group may reflect heightened engagement resulting from structured supervision and observation, as well as the physiological impact of the traditional games.

The implementation setting also presents potential external influences. Because the intervention was conducted in an open-field environment, student performance may have been affected by weather conditions, field quality, environmental distractions, and seasonal variability. Previous research indicates that environmental and seasonal factors can significantly influence physical activity levels and intensity among children (Garriga et al., 2022). In addition, variations in teacher enthusiasm, instructional style, and classroom climate may have further influenced student engagement and activity intensity during the sessions.

Furthermore, the relatively short duration of the intervention, consisting of six sessions, limits the ability to conclude long-term cardiovascular adaptation. While meaningful improvements were observed, sustained physiological adaptation generally requires longer, more consistent training exposure. Future studies are therefore encouraged to employ longer intervention periods and more controlled experimental conditions to strengthen internal validity and enhance generalizability.

CONCLUSION

The findings of this study confirm that structured traditional game-based physical activity has a significant positive effect on the cardiovascular endurance of fifth-grade students at SD Negeri Sambongpari. Compared to conventional PJOK instruction, the implementation of progressively intensified traditional games resulted in greater improvements in students' Foster Test scores, indicating that the intervention effectively enhanced cardiovascular endurance.

From a practical perspective, these results suggest that traditional games can be systematically designed as fitness-oriented learning strategies in elementary physical education. When implemented with progressive intensity and structured planning, traditional games can function not only as recreational activities but also as effective aerobic training stimuli aligned with children's developmental characteristics. Therefore, integrating traditional games into PJOK instruction may serve as an alternative approach to improving students' cardiovascular fitness while maintaining active participation and engagement.

However, this study has several limitations. The intervention was conducted in an open-field setting and was dependent on weather conditions, and the duration of implementation was relatively short (six sessions). These factors may limit the generalizability and long-term interpretation of the findings. Future research is therefore recommended to employ longer intervention periods, randomized designs, and more controlled environmental conditions in order to strengthen internal validity and provide a clearer understanding of the long-term impact of traditional game-based physical activity on cardiovascular endurance.

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