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Effect of Short-Interval Training on the Agility of Elementary School Students in Physical Education Classes

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Abstract

This study aimed to examine the effect of short-interval-based physical activity on students' agility in Physical Education, Sports, and Health (PJOK) at the elementary school level. Short-interval training is a structured exercise model performed at moderate to high intensity with brief recovery periods, designed to develop physical fitness components, particularly agility. The research employed a quasi-experimental pretest–posttest control group design. The participants were 54 students from SDN Sambongpari, divided into an experimental group (n = 27) and a control group (n = 27). The intervention was conducted over six instructional sessions. The experimental group received PJOK instruction integrated with short-interval training, while the control group followed conventional Intruction. Agility was measured using the standardized T-Test and analyzed through descriptive statistics, the Wilcoxon Signed-Rank Test, and the Mann–Whitney U test at a 0.05 significance level. The results showed a significant improvement in the experimental group ($p = 0.014 < 0.05$), whereas the control group showed no significant change ($p = 0.317 > 0.05$). The Mann–Whitney U test also revealed a significant difference between the experimental and control groups ($p = 0.013$), with $Z = -2.492$ and an effect size of $r = 0.34$, indicating a moderate between-group effect. The experimental group demonstrated an average improvement of 7.89% in agility performance, while the control group showed a decline of 1.30%. These findings indicate that short-interval training delivered over six sessions is effective for developing agility in elementary students. PJOK teachers can implement short-interval activities to promote practical learning outcomes in school settings.

Keywords Agility, Elementary School, Physical Education, Short-Interval Training.

INTRODUCTION

Physical education plays a fundamental role in shaping children's physical fitness and motor competence. Adequate physical activity not only supports physical health but also contributes to mental well-being and motor development (WHO, 2024). However, participation levels in physical activity among children and adolescents in Indonesia remain relatively low. A report by UNICEF (2022) indicates that approximately 57% of Indonesian children and adolescents do not meet the recommended levels of physical activity necessary to support healthy growth and development. This condition suggests that more than half of school-aged children are not sufficiently engaged in active movement. Limited physical activity may negatively affect physical development, including agility, which is a crucial component of physical fitness.

In elementary schools, physical education is not solely intended to develop physical aspects such as fitness and fundamental movement skills, but also to foster mental, emotional, social, and moral development through structured and enjoyable physical activities. Sari et al. (2024) emphasize that physical education serves as an effective medium for instilling character values and promoting lifelong healthy lifestyles. Permana (2020) further argues that physical education should ensure balance between students physical and psychological development. Dewantoro et al (2021) add that engaging exploration of basic movement patterns encourages active student participation.

Physical fitness levels are closely related to learning achievement in physical education. Supariyadi et al (2022) report that physically fit students tend to demonstrate better concentration and learning motivation. Nevertheless, Wahid (2023) found that the majority of students aged 10–12 years fall into the low fitness category based on the Indonesian Physical Fitness Test (TKJI), with 80% of female students classified as low or very low. Widiyanto and Putra (2021) highlight that TKJI results should serve as a reference for designing sustainable training programs.

Agility is one of the essential components of physical fitness that should be systematically developed during childhood. At the elementary school level, agility refers to the ability to move quickly and change direction accurately without losing balance (Arpansyah et al., 2022). This ability is closely related to children's neuromuscular maturation, coordination development, and balance control, which progressively improve during the growth phase. Sugiharto and Rejeki (2023) distinguish between open agility and closed agility; in elementary contexts, agility is generally trained through structured movement patterns such as shuttle runs and zig-zag runs that match children's developmental characteristics. Furthermore, agility is not only a physical ability but also involves rapid response to stimuli and efficient directional changes, reflecting the integration of perceptual and motor processes (Yulianto et al., 2024). Therefore, systematic and age-appropriate agility training is crucial to support optimal motor development during childhood.

Furthermore, agility development in children is influenced by biomotor components such as muscle strength, reaction time, balance, and coordination, which are highly responsive to structured and age-appropriate training stimuli (Husna et al., 2024). During the late childhood phase, motor skill acquisition becomes more refined, making this period particularly important for developing directional control and movement efficiency. Fadlu Rachman (2025) also emphasize that traditional and dynamic games are effective in supporting agility development in children because they involve rapid directional changes and adaptive motor responses in varied movement situations.

Structured training is necessary to optimize agility performance. Mustafa and Dwiyogo (2020) state that agility training should align with children's developmental stages to ensure safety and effectiveness. Donie et al (2022) emphasize that agility can be objectively measured using the T-Test, which evaluates multidirectional movement. Edila et al (2025) also found that cone drills and ladder drills significantly enhanced agility performance as measured by the T-Test.

One relevant approach to fostering agility is short-interval training. Previous studies have demonstrated that interval-based training positively influences physical fitness components. Rahmadani (2022) reported that interval training significantly affected physical fitness outcomes among elementary students, while Haryadi (2025) found notable effects on cardiovascular endurance. Mubarok (2022) explained that structured work–rest patterns stimulate physiological adaptation within the cardiorespiratory system, and Yunus et al (2023) highlighted that high-intensity interval training enhances energy system efficiency and directional movement ability.

However, existing studies have not specifically examined the implementation of short-interval training in the context of fourth-grade elementary school students within regular PJOK instruction. In addition, prior research has generally not applied a progressively structured training design tailored to the developmental characteristics of elementary learners. Furthermore, limited studies have utilized agility measurement based on the nationally standardized T-Test as an objective assessment instrument in elementary school settings.

Short-interval training is defined as high-intensity activity with brief recovery periods that effectively develops VO_2Max (Setiawan et al., 2024) International findings by Poon, et al (2023) confirm that short-interval training is safe and effective in supporting children's physical fitness and body composition. Fauzi et al (2020) also reported that high-intensity interval exercises support agility and speed through repeated neuromuscular stimulation.

Preliminary observations at SDN Sambongpari revealed that PJOK learning, particularly in agility-related material, has not yet applied systematically structured training patterns. Activities are generally limited to morning exercises, running laps around the field, and simple games without objective time measurement using a stopwatch. Based on the recap of athletic skill scores in the 2024/2025 academic year, approximately 86% of students demonstrated low results in agility aspects. Additionally, PJOK teachers have not previously implemented short-interval training within classroom instruction.

Considering these issues, experimental research is needed to examine the effect of short-interval-based physical activity on the agility of fourth-grade students at SDN Sambongpari. This study applies a Nonequivalent Control Group Design with a total sample of 54 students divided equally into two groups.

The novelty of this research lies in the progressive and measurable implementation of short-interval training within elementary PJOK instruction. This approach is expected to generate meaningful changes in students' agility performance while contributing to the academic discourse on the effectiveness of short-interval training in primary physical education contexts.

METHOD

This study employed a quantitative approach using a quasi-experimental method with a non-equivalent control group design. A pretest–posttest control group design was implemented to examine the effect of short-interval-based physical activity on students' agility in PJOK classes. Intact classes were used, and the assignment of classes as experimental and control groups was determined through random selection at the class level. The research design is presented as follows:

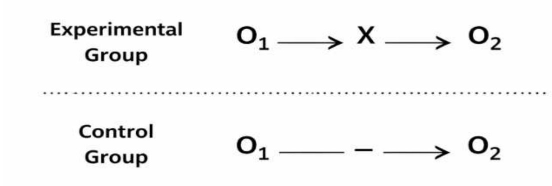

Figure 1. Quasi-Experimental Pretest–Posttest Control Group Design

Both groups completed a pretest to assess baseline agility. The experimental group received PJOK instruction integrated with short-interval training for six sessions, whereas the control group followed conventional instruction. A posttest was administered after the intervention period.

The participants consisted of 54 fourth-grade students from two existing classes at SDN Sambongpari. Because the study involved intact classroom groups, both classes were included in the research. One class was assigned as the experimental group ($n = 27$) and the other as the control group ($n = 27$).

This study utilized three data collection instruments: the T-Test as the primary instrument to assess agility, an observation sheet to monitor the implementation of the learning process, and an interview guide to obtain additional information. The use of these three instruments was intended to ensure that the data collected were comprehensive and aligned with the objectives of the study.

Agility was measured using the standardized T-Test. In addition, an observation sheet was used to monitor instructional implementation, and a semi-structured interview guide was employed to obtain supporting information.

Data were analyzed using descriptive and inferential statistics with a significance level of $\alpha = 0.05$. The decision criteria were: $p < 0.05$ indicates rejection of the null hypothesis (H_0), whereas $p \geq 0.05$ indicates failure to reject H_0.

Normality was tested using the Shapiro–Wilk test. Since the data were not normally distributed, nonparametric tests were applied. The Wilcoxon Signed-Rank Test was used to examine within-group differences (pretest vs posttest), and the Mann–Whitney U Test was used to compare posttest differences between groups.

Effect size was calculated using the formula $r = Z / \sqrt{N}$ and interpreted according to Cohen's criteria (0.10 = small, 0.30 = moderate, 0.50 = large).

A. Research Intrument

1. Agility Test (T-Test)

The primary instrument was the T-Test, based on national physical fitness assessment guidelines issued by the Ministry of Education, Culture, Research, and Technology (2024). The test was administered before (pretest) and after (posttest) the intervention to measure students' agility.

Four cones were arranged in a "T" formation. The distance from point A to B was 10 meters, while the distance from point B to C and B to D was 5 meters each. Students began behind the starting line at point A. Upon the command "Go," they sprinted to point B and touched the cone, moved laterally to points C and D alternately, returned to point B, and then ran backward to the finish line at point A. Time was recorded using a stopwatch. Each student performed the test twice, and the fastest time was recorded as the final score.

The agility indicators in this study were based on the concept of agility as the ability to change direction rapidly without losing balance. These indicators consisted of two primary aspects:

Table 1. Agility Indicators

No	Aspect/Dimension	Operational Indicator	Observed Behavioral Description	Assessed Technical Components	Measurement Method
1	Quick and precise directional change	The ability to change movement direction rapidly	Students are able to move forward, sideways, and backward without technical errors	Speed, step control, acceleration, and deceleration	Completion time in the T-Test
2	Balance and body coordination	The ability to maintain body stability during movement	Students maintain balance when touching cones or turning	Body positioning, foot and hand coordination	Movement accuracy and completion time

Source : Kemendikbud, 2024

Based on these indicators, test results were converted into agility categories according to the applicable normative standards.

Table 2. Agility Rubric (T-Test)

Male Score Range	Female Score Range	Conversion Score	Category
≤ 11,84 seconds	≤ 13,97 seconds	5	Excellent
11,85–18,83 seconds	13,98–20,96 seconds	4	Good
18,84–24,83 seconds	20,97–26,95 seconds	3	Moderate
24,84–30,83 seconds	26,96–32,95 seconds	2	Poor
≥ 30,84 seconds	32,96 seconds	1	Very Poor

Source: Kemendikbudristek, 2024

The scoring rubric is based on the time required to complete the T-Test course. Shorter completion times reflect stronger agility performance, while longer times indicate lower agility levels. This classification provides an objective description of students performance and facilitates comparison between pretest and posttest results.

Before being applied in the study, the instrument was adjusted to comply with national standards for physical fitness assessment. According to the developer's documentation, the instrument showed a validity coefficient of 0.376 and a reliability coefficient of 0.524, indicating an adequate level of consistency for educational measurement. The adoption of this standardized tool aimed to enhance the reliability and trustworthiness of the research results.

2. Observation

Observation was conducted throughout the instructional process to monitor student participation and the implementation of short-interval-based physical activities during PJOK lessons. A non-participant observation approach was applied, meaning the researcher observed classroom activities without directly engaging in the teaching process.

The purpose of the observation was to ensure that the intervention was carried out in accordance with the planned procedures and to document students involvement during the activities. The observational findings served as supplementary data to complement the quantitative results obtained from the agility test.

3. Interview

Semi-structured interviews were held with the PJOK teacher and the homeroom teacher to gain deeper insights into the learning process and the students characteristics during the research. These interviews were conducted after the intervention phase was completed.

The discussion with the PJOK teacher focused on exploring the effectiveness of the short-interval training program, students engagement throughout the activities, and any obstacles faced during implementation. In contrast, the interview with the homeroom teacher aimed to obtain a more comprehensive overview of students general traits, levels of participation, and progress in learning behavior. The information gathered from these interviews served as supplementary data to support and enrich the interpretation of the quantitative results obtained from the agility test.

B. Research Procedure

The study was implemented through a series of structured stages. Initially, both the experimental and control groups completed a pretest to measure their baseline agility using the T-Test. The procedures and testing environment were standardized for both groups to maintain consistency and objectivity in data collection.

Subsequently, the treatment phase was carried out over six instructional meetings for each group, not including the pretest and posttest sessions. The experimental group engaged in PJOK lessons incorporating short-interval physical training, such as zig-zag runs, lateral in-out drills, Squat, and jumping jacks, organized with clearly defined activity and rest intervals. In contrast, the control group received regular PJOK instruction without a structured interval-based approach.

Upon completion of the intervention period, both groups undertook a posttest using the same T-Test instrument to assess their final agility levels. The differences between pretest and posttest results were analyzed to determine the impact of short-interval physical training on students' agility.

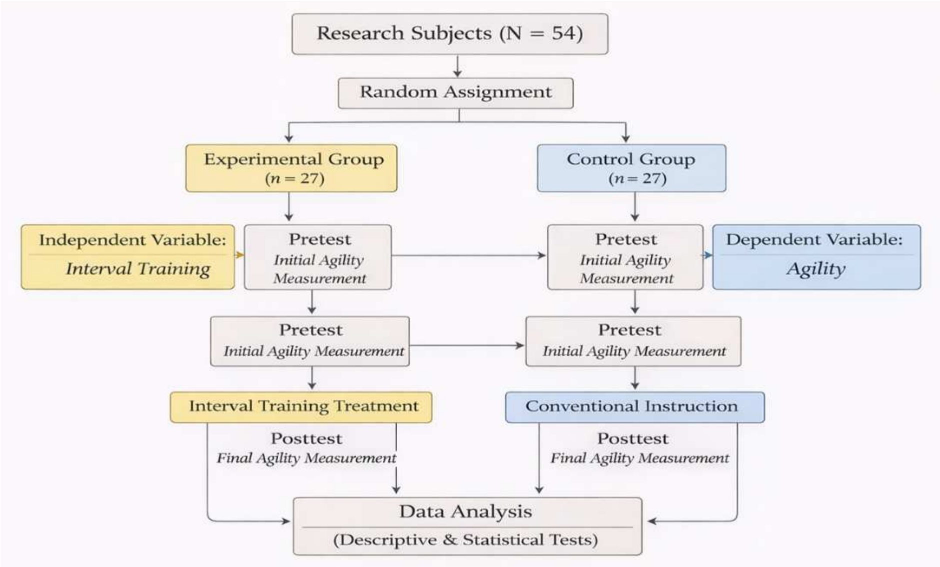

Figure 2. Quasi-Experimental Research Framework

C. Data Analysis

Pretest and posttest data were analyzed using both descriptive and inferential statistics. Descriptive statistics including the mean, standard deviation, minimum score, and maximum score were used to present an overview of students' agility performance in both the experimental and control groups.

Prior to hypothesis testing, prerequisite analyses were conducted. The normality of the data distribution was examined using the Shapiro-Wilk test, as the sample size in each group was fewer than 50 participants. Homogeneity of variance between the experimental and control groups was assessed using Levene's test. The data were considered to meet the assumptions for parametric analysis when the significance value exceeded 0.05 ($p > 0.05$).

If the data were not normally distributed, hypothesis testing was performed using a nonparametric approach, specifically the Mann-Whitney U test, to compare differences between the two groups. The level of significance was set at $\alpha = 0.05$. A p-value lower than 0.05 ($p < 0.05$) indicated a statistically significant difference between pretest and posttest scores.

FINDINGS AND DISCUSSION

This study aimed to examine the effect of short-interval-based physical activity on the agility of fourth-grade students at SDN Sambongpari. The findings are presented based on descriptive and inferential statistical analyses of pretest and posttest results from both the experimental and control groups.

A. Descriptive Statistics

1. Eksperimental Group

Table 3. Descriptive Statistics of Pretest and Posttest Results in the Experimental Group

	Pretest Eksperimen				
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Pretest_Eksperimen	27	2	3	2.81	.396
Valid N (listwise)	27				
	Posttest Eksperimen				
	N	Minimum	Maximum	Mean	Std. Deviation
Posttest_Eksperimen	27	3	4	3.04	.192
Valid N (listwise)	27				

Source: Output SPSS 27

Based on the descriptive analysis of the experimental group, a total of 27 students were included in the analysis. In the pretest data, the minimum score obtained by students was 2 and the maximum score was 3, with a mean of 2.81 and a standard deviation of 0.396. These results indicate that the students initial agility levels were generally classified within the moderate category, with relatively low data dispersion, suggesting that their abilities prior to the intervention were fairly homogeneous. In the posttest data, the minimum score increased to 3 and the maximum score to 4. The mean posttest score was 3.04 with a standard deviation of 0.192.

These findings demonstrate a statistically meaningful shift in the average agility performance of students after participating in short-interval-based physical activity. The lower standard deviation in the posttest suggests that students performance became more evenly distributed following the intervention, indicating that the observed progress was experienced consistently across the experimental group rather than limited to only a few individuals.

2. Control Group

Table 4. Descriptive Statistics of Pretest and Posttest Results in the control Group

		Pretest Kontrol			
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Pretest_Kontrol	27	2	3	2.85	.362
Valid N (listwise)	27				
		Posttest Kontrol			
	N	Minimum	Maximum	Mean	Std. Deviation
Posttest_Kontrol	27	2	3	2.81	.396
Valid N (listwise)	27				

Source: Output SPSS 27

Based on the descriptive analysis of the control group, 27 students were included in the study. In the pretest data, the minimum score was 2 and the maximum score was 3, with a mean of 2.85 and a standard deviation of 0.362. This average score indicates that the students initial agility levels were generally within the moderate category, with relatively low score dispersion, suggesting that their abilities were fairly homogeneous prior to the instructional period. In the posttest results, the minimum and maximum scores remained within the same range of 2 to 3. The mean posttest score was 2.81 with a standard deviation of 0.396.

These findings indicate that conventional instruction did not produce a statistically significant shift in the control group's average agility performance. In fact, there was a slight decline in the mean score compared to the pretest. The relatively small standard deviations in both measurements suggest that the variation in students abilities within the control group remained relatively stable across the two testing periods.

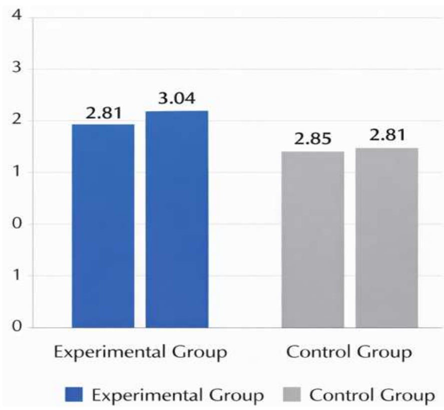

Figure 3. Comparison of Pretest and Posttest Mean Agility Scores Between Experimental and Control Groups

Figure 3 illustrates the comparison of pretest and posttest mean agility scores between the experimental and control groups. The experimental group demonstrated a higher posttest mean compared to its pretest score, whereas the control group showed a slight decline. This visual trend supports the statistical findings indicating the effectiveness of short-interval training in developing students' agility.

B. Tests of Normality (Shapiro-Wilk)

The normality test was conducted to determine whether the research data were normally distributed. In this study, the Shapiro-Wilk test was applied because the sample size in each group was fewer than 50 participants. Data analysis was performed using SPSS version 27. The results of the normality test are presented in the following table:

Table 5. Results of the Shapiro–Wilk Normality Test

Test of Normality						
	Kolmogrov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PretestKontrol	.511	27	.000	.427	27	.000
PosttestKontrol	.495	27	.000	.476	27	.000
PretestEksperimen	.495	27	.000	.476	27	.000
PosttestEksperimen	.539	27	.000	.193	27	.000

* This is a lower bound of the true significance
a. Lilliefors Significance Correction

Source: Output SPSS 27

Based on the results of the normality test presented in Table 5, all datasets yielded significance values of 0.000 (Sig. < 0.05). In the control group, both the pretest data showed significance values of 0.000 in the Kolmogorov-Smirnov and Shapiro-Wilk tests. Similarly, the posttest data in the control group also produced significance values of 0.000 in both tests. In the experimental group, the pretest results indicated p-values of 0.000 for both the Kolmogorov-Smirnov and Shapiro-Wilk tests. The same pattern was observed in the posttest data, with both normality tests yielding p-values of 0.000. Since all significance values were below 0.05 (Sig. < 0.05), it can be concluded that the pretest and posttest data in both groups were not normally distributed. Therefore, the assumption of normality was not satisfied, and subsequent analysis required the use of nonparametric statistical procedures.

C. Test of Homogeneity of Variance (Levene's Test)

The homogeneity test was conducted to determine whether the variance of agility data between the experimental and control groups was equal. Variance homogeneity was analyzed using Levene's test with the assistance of SPSS version 27. The decision criterion was as follows: if the significance value (Sig.) was greater than 0.05 (p > 0.05), the data were considered homogeneous; conversely, if the significance value was less than 0.05 (p < 0.05), the data were considered not homogeneous. The results of the homogeneity test are presented in the following table:

Table 6. Results of the Homogeneity Test

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
Pretest Eksperimen_Kontrol	Based on Mean	.518	1	52	.475
	Based on Median	.129	1	52	.721
	Based on Median and with adjusted df	.129	1	51.590	.721
	Based on trimmed mean	.518	1	52	.475
Posttest Eksperimen_Kontrol	Based on Mean	15.275	1	52	<,001
	Based on Median	3.059	1	52	.086
	Based on Median and with adjusted df	3.059	1	37.641	.086
	Based on trimmed mean	13.987	1	52	<.001

Source: Output SPSS 27

Based on the results of the variance homogeneity test presented in the Test of Homogeneity of Variance table, the pretest data for the experimental and control groups yielded a significance value (based on mean) of 0.475. Since this value is greater than 0.05 (p > 0.05), it can be concluded that the pretest variances of the two groups were homogeneous. In contrast, the posttest data showed a significance value (based on mean) of less than 0.001. Because this value is lower than 0.05 (p < 0.05), it indicates that the posttest variances between the experimental and control groups were not homogeneous. Therefore, the pretest data satisfied the assumption of homogeneity of variance, whereas the posttest data did not.

D. Hypothesis Test

Based on the results presented in Table 6, the pretest significance value based on the mean was 0.475 (Sig. > 0.05), indicating that the pretest variances were homogeneous. In contrast, the posttest significance value based on the mean was < 0.001 (Sig. < 0.05), demonstrating that the posttest variances were not homogeneous. Therefore, the assumption of homogeneity of variance was satisfied for the pretest data but not for the posttest data.

1. Wilcoxon Signed-Rank Test

The Wilcoxon Signed-Rank Test was conducted to examine differences in students' agility scores before and after the intervention within each group. This test was selected because the data did not meet the assumption of normal distribution. The results of the Wilcoxon test are presented in Table 7.

Table 7. Results of the Wilcoxon Signed Rank Test

Test Statistics[a]		
	Posttest_Kontrol - Pretest_Kontrol	Posttest_Eksperimen - Pretest_Eksperimen
Z	-1.000	-2.449
Asymp. Sig (2-*tailed*)	.317	.014

a. Wilcoxon Signed Rank Test
b. Based on negative ranks.

Source: Output SPSS 27

The Wilcoxon Signed-Rank Test revealed that in the control group, the significance value was 0.317 ($p > 0.05$), indicating no statistically significant difference between pretest and posttest scores. This finding suggests that conventional instruction did not produce meaningful changes in students' agility. In contrast, the experimental group obtained a significance value of 0.014 ($p < 0.05$), indicating a statistically significant difference between pretest and posttest scores after the short-interval training intervention. To determine the magnitude of the treatment effect, effect size (r) was calculated using the formula $r = Z / \sqrt{N}$. Based on $Z = -2.449$ and a sample size of $N = 27$, the calculated effect size was $r = 0.47$. According to Cohen's criteria (0.10 = small; 0.30 = moderate; 0.50 = large), this value represents a moderate-to-large effect. These findings indicate that short-interval training not only produced statistically significant improvements but also demonstrated substantial practical impact on students' agility performance. Meanwhile, no statistically or practically meaningful change was observed in the control group.

2. Mann-Whitney U test

Based on the results presented in Table 6, the pretest significance value (based on mean) was 0.475 ($p > 0.05$), indicating that the pretest variances were homogeneous. In contrast, the posttest significance value (based on mean) was less than 0.001 ($p < 0.05$), demonstrating that the posttest variances were not homogeneous. Therefore, the assumption of variance homogeneity was satisfied for the pretest data but not for the posttest data.

The Mann-Whitney U test was employed to determine whether there was a statistically significant difference in agility performance changes between the experimental and control groups after receiving different instructional treatments. The research hypothesis stated that short-interval-based physical activity would have a significant effect on the agility of fourth-grade students at SDN Sambongpari. The results of the Mann-Whitney U test are presented in the following table:

Table 8. Results of the Mann-Whitney U Test

Test Statistics[a]	Posttest_Eksperimen - Pretest_Eksperimen
Mann-Whitney U	286.000
Wilcoxon W	664.000
Z	-2.492
Asymp. Sig (2-tailed)	.013

a. Grouping Variable: Kode Posttest

Source: Output SPSS 27

The Mann-Whitney U test was used to compare agility performance between the experimental and control groups following the implementation of different instructional treatments. The analysis yielded a Mann-Whitney U value of 286.000, with a Z score of -2.492 and a significance value of 0.013 ($p < 0.05$). These results indicate a statistically significant difference in posttest outcomes between the two groups. Therefore, the null hypothesis (H_0) was rejected, and the alternative hypothesis (H_a) was accepted.

The magnitude of the effect was calculated using the effect size formula $r = Z / sqrt(N)$. With a total sample size (N) of 54, the calculated effect size was $r = 0.34$. According to Cohen's interpretation, this value falls within the moderate category. This finding suggests that the difference in agility performance between the experimental and control groups was not only statistically significant but also meaningful in practical terms within the context of elementary physical education instruction.

The statistical analysis demonstrates that short-interval training significantly improved students' agility in the experimental group and produced better outcomes than conventional instruction. The effect sizes indicate that the improvement was not only statistically significant but also meaningful in practical terms within the context of elementary physical education.

Discussion

The findings indicate that short-interval-based physical activity produced a statistically significant improvement in students' agility compared to conventional PJOK instruction. The experimental group demonstrated a significant pretest–posttest change ($p = 0.014 < 0.05$), whereas the control group showed no statistically meaningful difference ($p = 0.317 > 0.05$). In addition, the Mann–Whitney U test confirmed a significant difference in agility outcomes between the experimental and control groups ($p = 0.013 < 0.05$). In practical terms, the experimental group demonstrated an average gain of 7.89%, while the control group experienced a 1.30% decline. These results highlight that systematically implemented short-interval training is more effective for developing students' directional change ability than instruction delivered without a structured training program.

From a practical standpoint, short-interval training consists of moderate- to high-intensity activities interspersed with brief recovery periods. This work–rest structure likely supports gradual physiological and neuromuscular adaptation, enabling students to perform acceleration, deceleration, and rapid directional changes with greater control. Repeated and well-programmed movement tasks may also enhance coordination and responsiveness to dynamic movement stimuli, which are essential elements of agility. Moreover, structured and varied activities can increase student participation and motivation during PJOK lessons, consistent with evidence that innovative PJOK instruction fosters greater engagement in physical activity (Wicaksana et al., 2025).

From a theoretical perspective, these findings support motor learning theory, which posits that motor skills are acquired through structured practice and repeated experience, resulting in relatively permanent improvements in performance (Magill and Anderson, 2021). Within this framework, students refine movement patterns through repetition and feedback, and short-interval training provides consistent and measurable stimuli that may help the perceptual-motor system operate more efficiently. In addition, well-designed physical education programs may contribute to broader developmental outcomes, including character formation and life skills (Etkin, 2024).

The present results align with previous studies reporting beneficial effects of interval-based or structured drill training on fitness-related outcomes. Kurniawan and Soenyoto, (2025) found a strong association between interval training frequency and aerobic endurance ($\varrho = 0.731$; $p < 0.001$), supporting the view that systematic interval programming can induce meaningful physiological adaptation. Although their study focused on endurance rather than agility, both findings suggest that regular, structured interval stimuli can improve components of physical fitness. In the context of agility, Marwan et al. (2024) reported that ladder drill training significantly improved agility ($t = 4.75 >$ t-table 1.812), indicating that drills involving rapid directional changes effectively stimulate neuromuscular responses that enhance movement efficiency. Similarly, Alrizal et al (2024) reported improvements in agility-related performance through zig-zag training among elementary students; however, their descriptive design provides weaker causal evidence than the quasi-experimental approach used in the present study. The findings also reinforce prior evidence that interval methods and high-intensity physical activities can develop physical fitness components, including agility (Huda & Khotimah, 2025), and that systematic physical education supports meaningful learning experiences and comprehensive physical development (Widiyanto & Putra, 2021).

This study contributes evidence that short-interval training can be integrated into elementary PJOK using a progressive, structured design and evaluated with a standardized T-Test, strengthening both methodological rigor and practical relevance in school settings. Compared with many studies emphasizing aerobic endurance or sport-specific performance, this research provides more direct, context-relevant evidence for improving agility as a core fitness component in primary physical education. Despite these strengths, the study has limitations. It was conducted in a single school with a total sample of 54 students, which may limit generalizability, and the intervention was implemented over six instructional sessions. In addition, the study focused only on agility and did not examine other fitness components such as endurance, strength, or coordination. Future research is recommended to involve larger and more diverse samples, extend the intervention duration, and assess additional physical fitness outcomes to provide a more comprehensive understanding of short-interval training effects.

CONCLUSION

This study demonstrates that short-interval-based physical activity, as a structured and systematic training approach, plays a significant role in developing agility among elementary school students. The primary contribution of this research lies in offering a measurable, innovative, and practical training-based instructional model for Physical Education, Sports, and Health (PJOK). In addition, it reinforces the theoretical foundation of motor learning, which emphasizes the importance of repeated and goal-directed practice in mastering motor skills. Therefore, this study provides both theoretical and practical foundations for designing PJOK learning strategies that are more effective, contextual, and oriented toward meaningful development of students physical fitness.

From a practical perspective, the findings suggest that PJOK teachers can integrate short-interval training as an alternative instructional approach to foster agility and overall movement competence more effectively. A program designed progressively, with well-regulated intensity and proportional rest intervals, has been shown to produce more favorable outcomes than conventional instruction. However, this study is limited by its relatively small sample size and short intervention duration, which require cautious generalization of the findings. Future research is recommended to examine the long-term effects of short-interval training on other components of physical fitness, such as endurance, strength, and coordination, as well as to evaluate its effectiveness across different age levels and school contexts. Such efforts would further strengthen the validity of training-based interventions in enhancing the quality of physical education at the elementary level.

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