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Comparison of the Effects of Indonesian Healthy Gymnastics on Cardiovascular Endurance among Upper-Grade and Lower-Grade Elementary School Students in Urban and Rural Areas

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ABSTRACT

This study aimed to compare the effects of Indonesian Healthy Gymnastics on cardiovascular endurance among upper-grade and lower-grade elementary school students in urban and rural areas. A quantitative approach with a two-group pretest-posttest design was employed. The participants consisted of 48 elementary school students selected purposively from SDN 10 Buntu Pepasan and SDN 7 Buntu Pepasan, North Toraja Regency, South Sulawesi, Indonesia. Cardiovascular endurance was measured using the 6-Minute Run Test for lower-grade students and the 12-Minute Run Test for upper-grade students. Data were analyzed using descriptive statistics, the Shapiro-Wilk normality test, Levene's test, the Wilcoxon Signed Rank Test, and the Mann-Whitney U test. The results indicated a significant improvement in cardiovascular endurance after participation in Indonesian Healthy Gymnastics, as evidenced by the increase in mean scores from 1025.4 in the pretest to 1562.7 in the posttest ($p < 0.05$). Significant differences were also observed between students from urban and rural areas ($p = 0.032$) and between upper-grade and lower-grade students ($p = 0.015$). Although urban students demonstrated higher absolute gain scores, rural students exhibited greater percentage improvements (19.15%) compared with urban students (16.35%). Furthermore, upper-grade students achieved better cardiovascular endurance than lower-grade students, reflecting differences in physiological development and exercise adaptation. These findings suggest that Indonesian Healthy Gymnastics is an effective school-based aerobic exercise program for improving cardiovascular endurance among elementary school students. The study also emphasizes the necessity of considering developmental characteristics and environmental contexts when designing physical education programs. Consequently, age-appropriate and context-sensitive physical activity interventions are recommended to optimize children's health and physical fitness outcomes.

Keywords: cardiovascular endurance, elementary school, exercise, gymnastics, physical fitness

INTRODUCTION

Physical activity plays a fundamental role in promoting the growth, development, and overall health of school-aged children. Regular participation in physical activities contributes not only to physical fitness but also to cognitive development, emotional well-being, and social interaction. In the context of physical education, structured exercise programs are considered essential strategies for improving children's health and fostering lifelong healthy habits (World Health Organization, 2020). Among various forms of physical activity, gymnastics is recognized as an organized movement activity involving coordinated body movements that require strength, speed, flexibility, and rhythm. Gymnastics can be performed with or without equipment and has been widely implemented as an effective means of enhancing physical fitness and motor skills among children (Sembiring et al., 2024; Dewi, 2024).

One of the physical activity programs that has gained considerable attention in Indonesia is Indonesian Healthy Gymnastics (Senam Indonesia Sehat). This program combines aerobic movements with cheerful music and simple movement patterns that are suitable for

elementary school children. Previous studies have indicated that aerobic gymnastics can improve physical fitness, increase motivation to participate in physical activities, and enhance children's enjoyment during exercise sessions (Riyan, 2018). In addition, integrating gymnastics into physical education programs has been reported to positively influence cognitive functions such as concentration, memory, and problem-solving abilities (Kanahaya et al., 2024). Therefore, Indonesian Healthy Gymnastics represents a practical and accessible approach to promoting healthy lifestyles and physical fitness among elementary school students.

Cardiovascular endurance is one of the most important components of physical fitness because it reflects the ability of the heart, lungs, and circulatory system to supply oxygen efficiently during prolonged physical activity. Good cardiovascular endurance enables individuals to perform daily activities without excessive fatigue and supports participation in various physical and recreational activities. For children, cardiovascular fitness is particularly important because it is associated with improved academic performance, enhanced concentration, and reduced risk of chronic diseases later in life (Mahardika, 2015). Furthermore, cardiovascular endurance has been identified as a strong predictor of future health outcomes, making its development during childhood and adolescence a critical public health concern (Ortega et al., 2018).

The physiological responses to physical activity may vary according to age and developmental stages. Elementary school students in lower grades (Grades I–III) are generally characterized by early stages of motor and physiological development, whereas upper-grade students (Grades IV–VI) tend to possess more mature cardiovascular and respiratory capacities. Consequently, differences in age-related physiological characteristics may result in varying adaptations to exercise programs, including Indonesian Healthy Gymnastics. Previous research suggests that the effectiveness of physical training is influenced by biological maturity and developmental status, which may affect cardiovascular performance and exercise capacity among children (Armstrong & Welsman, 2019).

Besides age-related differences, environmental factors may also influence children's physical fitness. Students living in urban areas are often exposed to more sedentary lifestyles due to technological advancement and reduced opportunities for outdoor activities, despite having better access to sports facilities. In contrast, children residing in rural areas generally engage in more habitual physical activities associated with daily life and environmental conditions. These differences in lifestyle and physical activity patterns may contribute to variations in cardiovascular endurance and exercise adaptation between urban and rural students (World Health Organization, 2020). Therefore, investigating the interaction between geographical settings and structured exercise programs is essential for understanding the effectiveness of physical activity interventions among school-aged children.

Preliminary observations conducted at SDN 10 Buntu Pepasan and SDN 7 Buntu Pepasan revealed that Indonesian Healthy Gymnastics has been routinely implemented as part of school activities. However, no scientific evaluation has been conducted to compare its effects on cardiovascular endurance between upper-grade and lower-grade students and between schools representing different environmental characteristics. Differences in enthusiasm, movement coordination, and physical performance among students suggest that age and environmental context may influence physiological responses to exercise.

Research comparing the effects of Indonesian Healthy Gymnastics based on educational level and geographical setting remains limited, particularly in rural areas. Differences in infrastructure, habitual physical activity, and socio-environmental conditions may influence students' responses to physical education programs. Consequently, studies that simultaneously examine the effects of grade levels and residential environments are necessary to provide evidence-based recommendations for designing age-appropriate and context-sensitive physical activity programs.

The novelty of this study lies in its comparative analysis of the effects of Indonesian Healthy Gymnastics on cardiovascular endurance among upper-grade and lower-grade elementary school students in both urban and rural settings. Unlike previous studies that focused solely on the effectiveness of aerobic exercise programs, this study incorporates developmental and environmental factors to understand variations in physiological responses among children. The findings are expected to aid physical education teachers, school administrators, and policymakers in designing effective and inclusive physical activity programs that support children's health and physical fitness.

Therefore, this study aims to compare the effects of Indonesian Healthy Gymnastics on cardiovascular endurance among upper-grade and lower-grade elementary school students in urban and rural areas. We anticipate that the results will contribute to the development of physical education practices and provide empirical evidence for improving school-based health promotion programs.

METHODS

This study employed a quantitative approach using a two-group pretest-posttest design to compare the effects of Indonesian Healthy Gymnastics on cardiovascular endurance among upper-grade and lower-grade elementary school students in urban and rural settings. The design involved two experimental groups consisting of upper-grade students (Grades IV–VI) and lower-grade students (Grades I–III). Cardiovascular endurance was measured before and after the intervention to determine changes resulting from the exercise program. The study was conducted from February to March 2026 at SDN 10 Buntu Pepasan and SDN 7 Buntu Pepasan, North Toraja Regency, South Sulawesi Province. A total of 30 students aged 7–12 years were selected using purposive sampling based on the following criteria: being physically healthy, regularly attending the exercise sessions, willing to participate throughout the study, and having no medical conditions that could interfere with physical activity. The intervention consisted of Indonesian Healthy Gymnastics performed systematically with three stages, namely warm-up (7–10 minutes), core exercise (15–20 minutes), and cool-down (5 minutes). Cardiovascular endurance was assessed using the 6-Minute Run Test for lower-grade students and the 12-Minute Run Test for upper-grade students, both of which are widely recognized as valid and reliable measures of aerobic fitness in children (Cooper, 1968; World Health Organization, 2020).

Data collection involved pretest and posttest measurements accompanied by direct observation to ensure that participants performed the exercise correctly and consistently. The distance covered during the running tests was recorded and used as the indicator of cardiovascular endurance. Data analysis was conducted using SPSS version 26. Descriptive statistics were employed to determine the mean, standard deviation, minimum, and maximum values of the variables. Prior to hypothesis testing, normality was examined using the Kolmogorov–Smirnov test, while homogeneity of variance was assessed using Levene's test. Differences between pretest and posttest scores within each group were analyzed using the paired sample t-test, whereas differences between upper-grade and lower-grade students were examined using the independent sample t-test. Statistical significance was established at the 0.05 level. These procedures enabled the researchers to determine whether Indonesian Healthy Gymnastics produced significant improvements in cardiovascular endurance and whether the magnitude of improvement differed according to grade level and school environment.

RESULT AND DISCUSSION

Effect of Indonesian Healthy Gymnastics on Cardiovascular Endurance

The effectiveness of Indonesian Healthy Gymnastics in improving cardiovascular endurance was initially evaluated using descriptive statistical analysis. The descriptive statistics summarized the distribution of cardiovascular endurance scores before (pre-test) and after (post-test) the intervention, including the mean, standard deviation, minimum score, and maximum score. The results are presented in Table 1:

Table 1: Descriptive Statistics of Cardiovascular Endurance

Variable	N	Mean	Standard Deviation	Minimum	Maximum
Pre-test	48	1025.4	210.3	561	1688
Post-test	48	1562.7	320.5	1202	4483

Source: research data processing results

The descriptive analysis demonstrated a substantial improvement in students' cardiovascular endurance following participation in the Indonesian Healthy Gymnastics program. The average endurance score increased from **1025.4 m** during the pre-test to **1562.7 m** during the post-test, representing an average increase of **537.3 m**. Furthermore, the wider range of post-test scores suggests that many students achieved considerably higher endurance performance after the intervention.

Before hypothesis testing, the distribution of the data was examined using the Shapiro–Wilk normality test to determine the appropriate statistical procedure. The results are presented in Table 2:

Table 2: Shapiro–Wilk Normality Test

Variable	N	W Statistic	p-value	Interpretation
Pre-test	48	0.192	0.001	Not normally distributed
Post-test	48	0.894	0.000	Not normally distributed

Source: research data processing results

The Shapiro–Wilk test indicated that both pre-test and post-test data were not normally distributed ($p < 0.05$). Consequently, non-parametric statistical procedures were selected for hypothesis testing.

Homogeneity of variance was subsequently examined using Levene's Test. The findings are presented in Table 3:

Table 3: Homogeneity of Variance Test

Variable	Levene Statistic	p-value	Interpretation
Post-test	1.245	0.271	Homogeneous

Source: research data processing results

Since the significance value exceeded 0.05, the variance among groups was considered homogeneous. These findings indicate that, despite the non-normal distribution, the variability between the comparison groups remained relatively consistent.

To examine the effectiveness of Indonesian Healthy Gymnastics, the Wilcoxon Signed-Rank Test was employed. The results are summarized in Table 4:

Table 4: Wilcoxon Signed-Rank Test

Category	N	Mean Rank
Negative Ranks	0	0.00
Positive Ranks	48	24.50
Ties	0	-

Source: research data processing results

Table 5: Test Statistics

Statistic	Value
Z	-6.782
p-value	0.000

Source: research data processing results

The Wilcoxon Signed-Rank Test demonstrated a statistically significant improvement in cardiovascular endurance following participation in Indonesian Healthy Gymnastics ($Z = -6.782$, $p < 0.001$). No negative ranks were observed, indicating that every participant experienced improvement after the intervention. This finding provides strong statistical evidence that Indonesian Healthy Gymnastics effectively enhances aerobic fitness among elementary school students.

The observed improvement can be explained through physiological adaptations induced by aerobic exercise. Indonesian Healthy Gymnastics consists of rhythmic, continuous, and moderate-intensity movements that stimulate both cardiovascular and respiratory systems. Repeated participation increases cardiac output, stroke volume, pulmonary ventilation efficiency, and oxygen delivery to active skeletal muscles, thereby improving aerobic capacity and delaying fatigue. According to Armstrong and Welsman (2019), regular aerobic exercise promotes cardiovascular adaptations that significantly improve children's cardiorespiratory fitness. Similarly, McArdle, Katch, and Katch (2015) reported that repeated aerobic exercise enhances oxygen transport efficiency and muscular oxidative metabolism, resulting in improved endurance performance.

The present findings are consistent with previous studies demonstrating the effectiveness of school-based aerobic exercise programs. Ortega et al. (2018) identified cardiorespiratory fitness as one of the strongest predictors of children's present and future health. Likewise, Lubans et al. (2016) concluded that structured physical activity interventions significantly improve children's physical fitness and overall health status. Janssen and LeBlanc (2010) further emphasized that regular physical activity contributes positively to cardiovascular endurance, muscular fitness, and metabolic health.

Indonesian Healthy Gymnastics provides a practical, inexpensive, and sustainable exercise model that physical education curricula can easily incorporate. Besides improving cardiovascular endurance, the program encourages active participation, promotes healthy lifestyle behaviors, and supports long-term disease prevention. Considering that cardiovascular fitness established during childhood contributes to reduced risks of obesity, hypertension, diabetes, and cardiovascular disease later in life (World Health Organization, 2020), integrating Indonesian Healthy Gymnastics into regular school activities represents an effective strategy for enhancing children's health and physical fitness.

Comparison Between Urban and Rural Students

Differences in cardiovascular endurance improvement between students from urban and rural schools were analyzed using the Mann–Whitney U test. The results are presented in Table 5.

Table 6: Mann–Whitney U Test Comparing Urban and Rural Students

Statistic	Value
Mann–Whitney U	210.000
p-value	0.032

Source: research data processing results

The Mann–Whitney U test revealed a statistically significant difference in cardiovascular endurance improvement between students from urban and rural schools (p = 0.032). To better illustrate the magnitude of improvement, gain scores and percentage increases were calculated (Table 7).

Table 7: Comparison of Gain Scores Between Urban and Rural Students

Area	Sample	Mean Pre-test	Mean Post-test	Mean Gain	Percentage Increase
Urban	30	2126.67	2474.33	347.67	16.35%
Rural	30	1175.00	1400.00	225.00	19.15%

Source: research data processing results

Although urban students demonstrated larger absolute gain scores, rural students achieved a greater relative improvement (19.15%) compared with urban students (16.35%), representing a difference of **2.80%**.

This finding suggests that environmental characteristics influence the effectiveness of Indonesian Healthy Gymnastics. Rural children generally engage in more habitual physical activity through outdoor play, walking, and daily chores, enabling them to adapt more efficiently to aerobic exercise interventions. According to Sallis, Owen, and Fisher (2015), environmental opportunities substantially influence physical activity participation and fitness development. Similarly, Guthold et al. (2020) reported that sedentary lifestyles are considerably more prevalent among urban children because of increased screen time and reduced outdoor activities. Therefore, the greater percentage improvement observed among rural students likely reflects cumulative adaptations associated with more active lifestyles.

Comparison Between Upper-Grade and Lower-Grade Students

Differences according to grade level were evaluated using another Mann–Whitney U test. The results are presented in **Table 8**.

Table 8: Mann–Whitney U Test Comparing Upper- and Lower-Grade Students

Statistic	Value
Mann–Whitney U	180.500
p-value	0.015

Source: research data processing results

The results demonstrated a statistically significant difference between upper-grade and lower-grade students (p = 0.015). Upper-grade students exhibited greater improvements in cardiovascular endurance than lower-grade students.

These findings can be attributed to biological maturation. Older children generally possess larger cardiac dimensions, greater lung capacity, higher blood volume, and stronger skeletal muscles, enabling them to respond more effectively to aerobic training. Malina, Bouchard, and Bar-Or (2004) explained that biological maturation significantly influences children's aerobic performance, whereas Armstrong and Welsman (2019) demonstrated that maximal oxygen uptake progressively increases throughout childhood and adolescence.

Consequently, upper-grade students exhibited greater physiological adaptations to Indonesian Healthy Gymnastics.

Comparative Effects Among the Four Groups

To further investigate intervention effectiveness, gain percentages were compared across four experimental groups. The results are presented in **Table 8**.

Table 8. Percentage Improvement Across the Four Experimental Groups

Group	Mean Gain	Percentage Improvement
Group 1	395.33	17.94%
Group 2	300.00	14.63%
Group 3	250.00	20.83%
Group 4	200.00	17.39%

The greatest improvement was achieved by Group 3 (20.83%), followed by Group 1 (17.94%), Group 4 (17.39%), and Group 2 (14.63%). These differences indicate that the effectiveness of Indonesian Healthy Gymnastics is influenced not only by the intervention itself but also by participant characteristics and environmental context. Bandura's (1986) Social Cognitive Theory suggests that exercise behavior results from interactions among individual motivation, environmental support, and behavioral engagement. Students who receive stronger social support and demonstrate higher motivation are generally more consistent in participating in physical activity programs and therefore experience greater physiological adaptations.

Overall, the findings consistently demonstrate that Indonesian Healthy Gymnastics is an effective intervention for improving cardiovascular endurance among elementary school students. Nevertheless, the magnitude of improvement varies according to residential environment, grade level, and participant characteristics. These results highlight the importance of designing age-appropriate and context-sensitive physical education programs that consider environmental influences and developmental differences. Consequently, Indonesian Healthy Gymnastics may be recommended as an evidence-based school physical activity program capable of improving children's cardiovascular fitness while supporting long-term health promotion.

CONCLUSION

This study demonstrates that Indonesian Healthy Gymnastics is an effective school-based aerobic exercise program for improving cardiovascular endurance among elementary school students. The descriptive analysis revealed a substantial increase in the mean cardiovascular endurance score from 1025.4 m during the pre-test to 1562.7 m during the post-test. The Wilcoxon Signed-Rank Test further confirmed that this improvement was statistically significant ($Z = -6.782$, $p < 0.001$), indicating that all participants experienced positive gains following the intervention. Comparative analyses also showed significant differences according to residential setting and grade level. Rural students achieved a higher relative improvement (19.15%) than urban students (16.35%), while upper-grade students demonstrated greater gains than lower-grade students. Furthermore, Group 3 recorded the highest percentage improvement (20.83%), suggesting that age, developmental status, and environmental context influence the effectiveness of aerobic exercise interventions.

Overall, the findings provide robust evidence that Indonesian Healthy Gymnastics is a practical, low-cost, and sustainable strategy for enhancing cardiovascular endurance among elementary school students. Beyond improving physical fitness, the program has considerable

potential to strengthen school-based physical education, encourage lifelong participation in physical activity, and contribute to long-term health promotion. These findings support the integration of Indonesian Healthy Gymnastics into regular school curricula as an evidence-based approach to improving children's cardiorespiratory fitness. Future research should involve larger and more diverse populations, employ longer intervention periods, and incorporate direct physiological measurements such as maximal oxygen uptake (VO_2max) to further validate and extend the present findings.

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