

Effects of aerobic exercises on physical fitness of primary school children

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ABSTRACT

The effects of aerobic exercises on physical fitness in school children have not yet been examined in the context of Vietnam. The aim of this study was to verify the effects of aerobic exercises on physical fitness of primary school children. This study was a controlled trial involving 64 third-grade primary school children, all aged 8 years, from Vinh City, Vietnam. Participants voluntarily took part and were randomly assigned to either the aerobic exercise group (AG) or the control group (CG), with 32 children in each group (16 males and 16 females per group). Five physical fitness tests were conducted: handgrip strength (upper-body strength), 30-second sit-ups (abdominal endurance), standing long jump (leg power), 30-meter sprint (speed), and 4×10 m shuttle run (agility). After eight weeks of intervention, the aerobic exercise group (AG) showed significantly greater improvements than the control group (CG) in upper- and lower-extremity strength, abdominal strength, speed, body control, and endurance ($p < 0.05$). These findings suggest that aerobic exercise effectively enhances muscular strength, speed, agility, and overall endurance in primary school children.

KEYWORDS

Aerobics; Exercise; Physical Health; Children; Primary School

1. INTRODUCTION

Recently, children engage in many other sedentary behaviours such as sitting in the classroom doing homework (Olds et al., 2020) and spend approximately 8 hours per day sedentary (Verloigne et al., 2022). The evidence suggests that daily TV viewing in excess of 2 hours is associated with reduced physical and psychosocial health, and that lowering sedentary time leads to reductions in BMI (Tremblay et al., 2011). Promoting a healthy lifestyle by reducing sedentary behaviour due to

excessive use of the internet or audio-visual media as well as increasing physical activity is indispensable (Damian et al., 2018).

Physical exercise plays an important role in enhancing physical fitness and wellbeing. Physical exercise can improve the physical fitness and executive functions (Zhang et al., 2023). Regular physical activity, active play and sports can be a practical means to achieving numerous health gains, either directly or indirectly through its positive impact on other major risks, in particular high blood pressure, high cholesterol, obesity, and stress (World Health Organization, 2003). There is clear evidence that regular physical activity contributes to the primary and secondary prevention of several chronic diseases and is associated with a reduced risk of premature death (Warburton et al., 2006). In addition, regular participation in play, games and other physical activities, both in school and during free time, is essential for the healthy development of every young person (World Health Organization, 2003). Furthermore, exercise is any activity that helps to improve or maintain physical fitness as well as in general. People of all ages, both male and female can benefit from regular exercise (Gulam, 2016). Recent studies prove that daily exercises can reduce stress and anxiety, boost happy chemicals, improve self-confidence, increase the brain power, sharpen the memory and increase our muscles and bones strength, and improve quality of life (Elmagd, 2016).

Aerobic fitness is be defined as “the ability to deliver oxygen to the muscles and to utilize it to generate energy to support muscle activity during exercise”. Both aerobic and anaerobic exercises have unique and collective positive correlations towards improved cardiovascular diseases health (Patel et al., 2017). Aerobic exercise involves the continuous and rhythmic use of large muscle groups, such as walking, jogging, cycling, and swimming. Aerobic fitness is also defined as the ability to deliver oxygen to the muscles and to utilize it to generate energy during exercise (Armstrong, 2006). Previous studies also have proven the effect of aerobic exercises on promoting physical fitness and cognitive in the children with overweight reducing anxiety of the developmental coordination disorder children and also improving quality of life, academic outcomes and physical activity (Sujatha et al., 2020), bringing a positive effect on the body composition of children and young people (Djordjevic et al., 2021), and also enhancing academic achievement in children (Chaddock et al., 2012; Kao et al., 2017).

To our knowledge, there are few studies concerning the effects of aerobic exercise on physical fitness in school children in context of Viet Nam. Consequently, the main aim of this study is to verify the effectiveness of aerobic exercise training on physical health of primary school children.

2. METHODS

2.1. Participants

This was a controlled trial study. A total of 64 primary school children aged 8 years at the third grade in Vinh city, Vietnam voluntarily participated in this study. They were divided into experimental group (EG) and control group (CG). The number of participants in each group is 32. Each group has 32 subjects (16 males, 16 females). Prior to the recruitment, parents were asked to report their child's health history, and signed the consent of participation in this study. Exclusion criteria: participants have chronic pediatric diseases or orthopedic condition that would limit to perform exercises. Table 1 below describes the general information of the two research groups.

Table 1. General anthropometry of the two research groups

Variable	Aerobic Exercise Group	Control Group
Total	32	32
Male	16	16
Female	16	16
Weight (kg)	28.34 ± 2.90	28.33 ± 2.86
Height (m)	1.29 ± 0.019	1.29 ± 0.018
BMI (kg/m ²)	16.86 ± 1.85	16.79 ± 1.81

Note. BMI: Body Mass Index

2.2. Procedure

Subjects in aerobic exercise group were instructed to do aerobic exercises in eight weeks, two times a week out of class time. Each training session lasted 45 minutes contained of 10-minute warm-up, 10-minute cool down and 25-minute main part. Participants in control group were asked not to participate in any new physical program but still followed normal physical lesson at school in class time. The same instructors tested and trained the same participants and the physical tests were performed in the same order with identical equipment, positioning, and technique. Subject of both group were tested before and after intervention (pre and post). Selected aerobic exercises used in this study were seven basic steps of aerobic exercise (Fédération internationale de gymnastique, 2012). These basis steps are following: March, Jog, Skip, Knee lift, Kick, Jack, Lunge.

2.3. Outcome Measures and Data Collection

- **Test 1: Handgrip strength (kg):** to measure the maximum isometric strength of the hand and forearm muscles (Roberts et al., 2011). The subject holds the dynamometer in the hand to be tested, with the arm at right angles and the elbow by the side of the body. The handle of the dynamometer is adjusted if required - the base should rest on the first metacarpal (heel of palm),

while the handle should rest on middle of the four fingers. When ready the subject squeezes the dynamometer with maximum isometric effort, which is maintained for about 5 seconds. No other body movement is allowed. The subject should be strongly encouraged to give a maximum effort.

- **Test 2: 30 seconds Sit-ups (times):** to measure abdominal muscular strength and endurance of the abdominals and hip-flexors, important in back support and core stability (Wood, 2008a). The aim of this test is to perform as many sit-ups as you can in 30 seconds. The subjects lie on the mat with the knees bent at right angles, with the feet flat on the floor and held down by a partner. The fingers are to be interlocked behind the head. On the command 'Go', raise the chest so that the upper body is vertical, then return to the floor. Continue for 30 seconds. For each sit up the back must return to touch the floor.

- **Test 3: Standing long jump (cm):** to measure the explosive power of the legs (Wood, 2008b). The subject stands behind a line marked on the ground with feet slightly apart. A two foot take-off and landing is used, with swinging of the arms and bending of the knees to provide forward drive. The subject attempts to jump as far as possible, landing on both feet without falling backwards. Three attempts are allowed.

- **Test 4: 30 meter sprint (s):** to determine acceleration and speed (Wood, 2008b). The test involves running a single maximum sprint over 30 meters, with the time recorded. A thorough warm up should be given, including some practice starts and accelerations. Start from a stationary position, with one foot in front of the other. The front foot must be on or behind the starting line. This starting position should be held for 2 seconds prior to starting, and no rocking movements are allowed. The tester should provide hints for maximizing speed (such as keeping low, driving hard with the arms and legs) and encourage them to continue running hard through the finish line.

- **Test 5: 4x10m shuttle running (s):** to test speed, body control and the ability to change direction (agility) (Wood, 2008a). Mark two lines 10 meters apart using marking tape or cones. The two blocks are placed on the line opposite the line they are going to start at. On the signal "ready", the participant places their front foot behind the starting line. On the signal, "go!" the participant sprints to the opposite line, picks up a block of wood, runs back and places it on or beyond the starting line. Then turning without a rest, they run back to retrieve the second block and carry it back across the finish line. A total of 40m is covered. Two trials are performed.

2.4. Data Analysis

The Statistical Package of Social Sciences (SPSS) was used for data analysis. The statistical significance has been estimated at probability (p-value) equal or less than 0.05. Data are expressed as means \pm standard deviation. Paired sample test and analysis of variance (anova) were performed to analyse the differences of pre-test and post-test within and between groups.

3. RESULTS

Table 2 shows the changes in physical test results for the control group, comparing their performance before and after the intervention period.

Table 2. Comparison of physical tests changes in the control group

Tests	Test time	Mean	SD	t value	p value
Handgrip strength (kg)	Pretest	12.65	1.08	.04	.96
	Posttest	12.66	1.07		
Sit up (times/30s)	Pretest	12.00	2.24	.72	.476
	Posttest	11.90	2.38		
Standing long jump (cm)	Pretest	130	7.76	.73	.467
	Posttest	131	7.78		
30m sprint test (s)	Pretest	7.23	.55	.98	.331
	Posttest	7.21	.58		
4x10m shuttle running (s)	Pre-test	13.83	2.19	1.23	.228
	Posttest	14.25	.96		

The results in Table 2 indicated that after eight weeks of aerobic exercises training, there were no remarkable differences in all physical tests for the test time (pretest and posttest) of the control group ($p > 0.05$). These results of all test proved that there were no significant differences in strength of lower and upper extremities and abdomen; speed, body control and endurance with p value $> .05$. Below, Table 3 shows the changes in physical test results for the experimental group, comparing their performance before and after the intervention or training program. The results show that after eight weeks of aerobic exercises training, there were remarkable differences in all physical tests for the test time of EG ($p < .000$). That explained for the significant differences in strength of lower and upper extremities and abdomen; speed, body control and endurance with p value $< .05$.

Table 3. Comparison of physical tests changes in the experimental group

Tests	Test time	Mean	SD	t value	p value
Handgrip strength (kg)	Pretest	12.72	1.04	5.29	.000
	Posttest	14.04	2.04		
Sit up (times/30s)	Pretest	12.18	2.14	8.43	.000
	Posttest	14.09	2.88		
Standing long jump (cm)	Pretest	130	8.53	11.27	.000
	Posttest	134	7.76		
30m sprint test (s)	Pretest	7.15	.57	11.96	.000
	Posttest	6.87	.54		
4x10m shuttle running (s)	Pre-test	14.29	1.01	7.95	.000
	Posttest	13.68	1.02		

Table 4 presents a comparison of physical test results between both study groups before the intervention, showing whether there were any initial differences.

Table 4. Comparison of physical tests changes between EG and CG before intervention

Tests	EG (n=32)		CG (n=32)		f value	p value
	Mean	SD	Mean	SD		
Handgrip strength (kg)	12.72	1.04	12.65	1.08	.07	.793
Sit up (times/30s)	12.18	2.14	12.00	2.24	.11	.734
Standing long jump (cm)	130	8.53	130	7.76	.03	.861
30m sprint test (s)	7.15	.57	7.23	.55	.26	.607
4x10m shuttle running (s)	14.29	1.01	13.83	2.19	1.19	.279

It can be observed from Table 4 that there were no significant differences between the two groups in any of the tests before the intervention, including strength of the lower and upper extremities and abdomen, as well as speed, body control, and endurance.

Table 5 shows a comparison of physical test results between both study groups after the intervention, indicating the differences in performance changes resulting from the training or program.

Table 5. Comparison of physical tests changes between EG and CG after intervention

Tests	EG (n=32)		CG (n=32)		F value	p value
	Mean	SD	Mean	SD		
Handgrip strength (kg)	14.04	2.04	12.66	1.07	11.50	.001
Sit up (times/30s)	14.09	2.88	11.90	2.38	10.90	.002
Standing long jump (cm)	134	7.76	131	7.78	5.47	.023
30m sprint test (s)	6.87	.54	7.21	.58	5.80	.019
4x10m shuttle running (s)	13.68	1.02	14.25	.96	5.27	.025

The results of Table 5 showed that there were significant differences between two groups for four tests. Namely, handgrip strength test ($F = 11.50, p = .001$) data observed from figure 1; sit-up test ($F = 10.901, p = .002$) data observed from figure 2; standing long jump test ($F = 5.470, p = .023$) data observed from figure 3; 30-meter sprint test ($F = 5.807, p = .019$) data observed from figure 4; 4x10m shuttle running test ($F = 5.275, p = .025$) data observed from figure 5. This means that after eight weeks of intervention, the results of tests for strength of lower extremities and abdomen; speed, body control and endurance of AG showed significantly better than those of CG with $p < .05$, respectively.

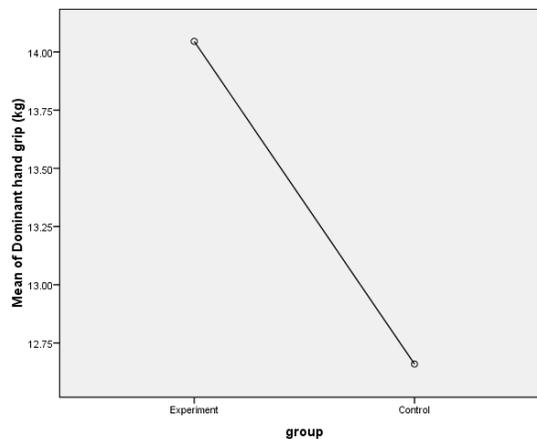


Figure 1. Mean of dominant hand grip between the study groups after intervention

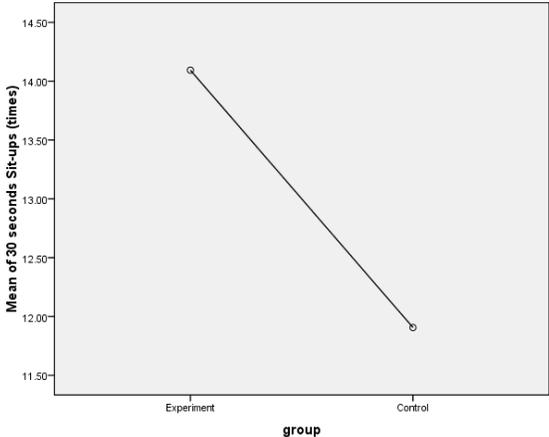


Figure 2. Mean of 30-second sit-ups between the study groups after intervention

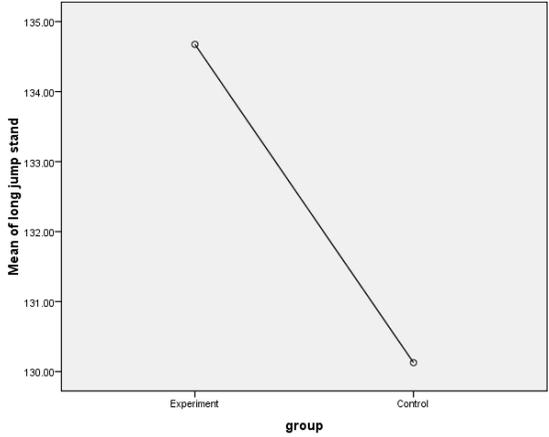


Figure 3. Mean of long jump stand between the study groups after intervention

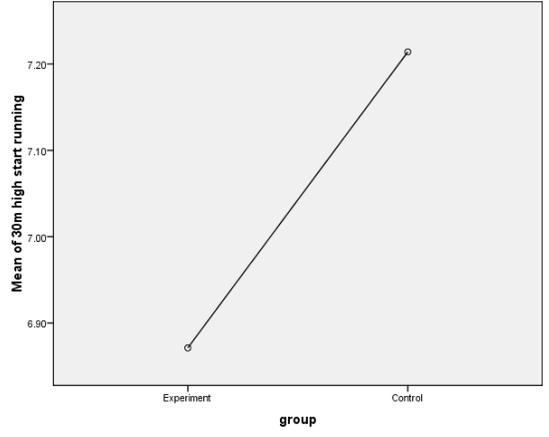


Figure 4. Mean of 30m high start running between the study groups after intervention

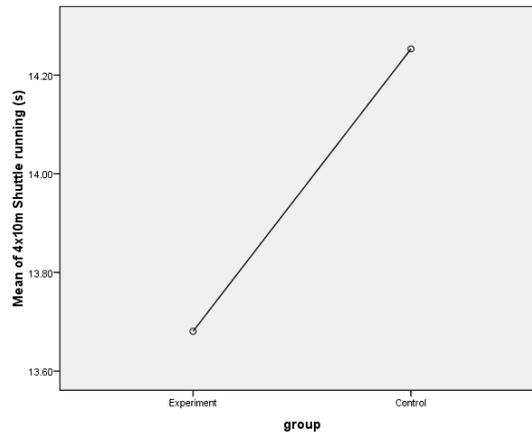


Figure 5. Mean of 4x10m shuttle running between the study groups after intervention

4. DISCUSSION

After 8 weeks of aerobic exercise training, participants in aerobic exercise group outperformed the control group in strength of upper and lower extremities and abdomen; speed, body control and endurance of primary school children. Previous finding proved that physical activity plays an important role in maintaining and promoting lifestyle and health of individuals (Lightfoot et al., 2018). Scientific studies in children showed that physical activity can increase their growth and reduce their health problems (Noonan et al., 2016). The result of this study is also somehow in accordance with the results that suggested aerobics program improve the majority of the fitness abilities (Tošić et al., 2011), and physical activity and exercise as a vehicle for improving health (Downward & Rasciute, 2015), increases cardiovascular performance and respiratory fitness (Sofi et al., 2008). Aerobic training has also been observed to decrease body weight from both the fat and muscle compartments while strength training conserved the lean body mass and reduced the fat compartment and thus caused favorable body composition in females (Lehri & Mokha, 2006).

Another finding proved that practicing aerobics was found to be effective in bringing significant improvements in flexibility, concentration, and physical fitness (Sarojini et al., 2019) and aerobic exercise, then, may be an invaluable part of children’s development, and these findings should persuade parents and educators to reconsider the importance of aerobic exercise (Best, 2010). The results of this study are also in accordance with the results of previous study, which showed that combining aerobics could be effective in improving motor skills (Zarian et al., 2021).

The results of this study are consistent with previous findings showing that aerobic and resistance training provide several benefits, such as improved metabolic capacity and

cardiorespiratory fitness (McArdle et al., 2001). Furthermore, the positive outcomes observed in this study highlight the importance of incorporating structured aerobic exercise programs into school curricula to promote overall physical development and health among children. Regular participation in such activities not only enhances physical fitness components such as strength, endurance, and coordination but also contributes to improved mental well-being, concentration, and academic performance. These findings emphasize that early engagement in organized physical exercise can establish lifelong healthy habits, reduce the risk of obesity and chronic diseases, and foster a more active lifestyle during adolescence and adulthood. Therefore, educators and policymakers should prioritize the integration of aerobic exercise programs in schools to ensure the holistic development of children.

5. LIMITATIONS

Although the study successfully achieved its research aim, several limitations should be acknowledged. First, there may be a bias between the research groups, as the aerobic exercise group participated in specific training activities while the control group did not. Additionally, the small sample size may limit the generalizability of the findings to a larger population. Future studies could include different types of exercises for each group to minimize potential bias and should consider a larger sample size to enhance representativeness. Furthermore, the current study included mixed-gender groups, which may have influenced the results. It is therefore recommended that future research examine unmixed gender groups to provide clearer insights into gender-specific responses to exercise interventions.

6. CONCLUSIONS

After 8 weeks of aerobic training, aerobic exercises have been found to improve the physical fitness of primary school children. Based on the results, the aerobic exercises are beneficial for enhancing strength of upper and lower extremities and abdomen; speed, body control and endurance of primary school children. We recommended that aerobic exercises can be widespread in schools to contribute to improving physical health of school children.

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AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

FUNDING

This research received no external funding.

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