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Effects of Continuous Aerobic Training on Body Composition in Primary School Boys

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ABSTRACT

The prevalence of sedentary lifestyles among children has increased significantly in recent decades, leading to higher rates of overweight, obesity, and reduced physical fitness. School-based exercise programs are considered an effective strategy to improve body composition and promote health in children. The purpose of the present study was to investigate the effects of a structured continuous aerobic training program on body composition among primary school boys aged 10–12 years in Shahriar County, Iran. This research employed a quasi-experimental design with pre-test and post-test measurements and included a control group. Twenty students were randomly assigned to two groups: a continuous training group (n=10) and a control group (n=10). Body composition variables, including body fat percentage, fat-free mass, and basal metabolic rate, were measured using a bioelectrical impedance analyzer (InBody 0.3, Korea). Anthropometric variables such as waist circumference, hip circumference, arm circumference, and thigh circumference were also recorded. The training program lasted 12 weeks and consisted of three weekly sessions with progressive intensity ranging from 60% to 75% of maximum heart rate. Statistical analysis was conducted using descriptive statistics, Kolmogorov–Smirnov tests for normality, and analysis of variance (ANOVA). Results showed a significant improvement in body composition in the training group compared with the control group ($p = 0.002$). Participants who completed the exercise intervention demonstrated reductions in body fat percentage and improvements in lean body mass. These findings suggest that continuous aerobic training programs implemented within school settings can effectively improve body composition and promote physical health in children. The results highlight the importance of integrating structured physical activity into school curricula to prevent childhood obesity and improve long-term health outcomes.

Keywords: *continuous training, body composition, primary school students, body fat percentage.*

1. Introduction

Physical activity is an essential component of healthy growth and development in children. Regular participation in physical activity contributes to improved cardiovascular fitness, better metabolic health, and favorable body composition during childhood and adolescence (1). Conversely, insufficient physical activity has been associated with increased risk of obesity, cardiovascular disease, and metabolic disorders later in life (2). Over the past several decades, global levels of physical activity among children have declined substantially. Rapid technological development and increased availability of digital entertainment have contributed to increased sedentary behaviors among youth, including prolonged screen time and reduced outdoor play (3). These lifestyle changes have led to significant increases in childhood overweight and obesity worldwide. Childhood obesity has become a major global public health issue. Epidemiological studies indicate that the prevalence of overweight and obesity among children has increased dramatically over the past few decades in both developed and developing countries (4). Excess body fat during childhood is associated with numerous health risks, including hypertension, insulin resistance, dyslipidemia, and early onset of cardiovascular disease (5). Furthermore, obesity during childhood often persists into adulthood, increasing the risk of long-term health complications (6). Body composition is considered an important indicator of health and physical fitness. It refers to the relative proportions of fat mass and fat-free mass in the body. Excess body fat is associated with increased metabolic and cardiovascular risk, whereas higher lean body mass is associated with improved functional capacity and physical performance (7). Cardiorespiratory fitness is another important determinant of health in children and adolescents. It reflects the capacity of the cardiovascular and respiratory systems to deliver oxygen to working muscles during physical activity (8). Studies have demonstrated that children with higher levels of cardiorespiratory fitness tend to have lower body fat levels and reduced risk of metabolic diseases (9). Regular aerobic exercise has been shown to improve body composition by increasing energy expenditure and stimulating lipid metabolism. Aerobic exercise enhances mitochondrial function and improves the body's ability to oxidize fatty acids, leading to reductions in body fat mass (10). These physiological adaptations contribute to improved metabolic health and overall physical fitness. Continuous aerobic training is one of the most commonly used exercise methods to improve cardiovascular fitness and body composition. Continuous training involves sustained aerobic activity performed at moderate intensity for extended periods of time (11). This form of exercise is considered particularly appropriate for children because it is easy to implement, requires minimal equipment, and has a relatively low risk of injury (12). Schools represent an important setting for promoting physical activity among children. Because students spend a large portion of their day in school environments, physical education programs and school-based exercise interventions provide valuable opportunities to increase physical activity levels (13). Previous research has shown that structured physical activity programs implemented in schools can significantly improve physical fitness and reduce body fat among children (1). Despite these benefits, many schools provide limited time for physical education, and students often do not engage in sufficient levels of physical activity during school hours (14). As a result, designing effective and feasible exercise interventions that can be implemented within school settings remains an important research priority. Therefore, the aim of the present study was to investigate the effects of a 12-week continuous aerobic training program on body composition in primary school boys in Shahriar County. It was hypothesized that participation in regular continuous aerobic training would significantly improve body composition compared with a control group.

2. Methods and Materials

2.1. *Study Design*

This study used a quasi-experimental research design with pre-test and post-test measurements and a control group. The objective was to evaluate the effects of a continuous aerobic training program on body composition variables among primary school boys.

2.2. *Participants*

The study population consisted of male students enrolled in primary schools in Shahriar County, Iran. Twenty students aged between 10 and 12 years volunteered to participate in the study. Participants were randomly assigned to two groups:

- Continuous training group (n = 10)
- Control group (n = 10)

Participants were screened to ensure that they were healthy and able to participate in physical activity. Students with cardiovascular, respiratory, or musculoskeletal disorders were excluded from the study. Written informed consent was obtained from parents or guardians prior to participation.

2.3. *Anthropometric Measurements*

Anthropometric measurements were conducted according to standardized procedures. Height was measured using a digital stadiometer (Soehnle, Germany) with a precision of 0.5 cm. Body weight was measured using a digital scale with a precision of 0.01 kg. Body mass index (BMI) was calculated as:

BMI = weight (kg) / height² (m²)

Body composition variables were assessed using bioelectrical impedance analysis (InBody 0.3, Korea), which is a widely used non-invasive method for estimating body composition in clinical and field settings (15). Participants were instructed to avoid heavy meals and excessive fluid intake for at least three hours before measurements. Measured body composition variables included: Body fat percentage; Fat-free mass; Basal metabolic rate. Additional anthropometric measurements included: Waist circumference; Hip circumference; Arm circumference; Forearm circumference; Thigh circumference; Calf circumference. These measurements were obtained using a flexible anthropometric tape.

2.4. Exercise Intervention

Participants assigned to the experimental group completed a 12-week continuous aerobic training program. Training sessions were conducted three times per week, with each session lasting approximately 40 minutes. Each session consisted of three sequential phases including a warm-up, the main aerobic exercise phase, and a cool-down period. The warm-up lasted 5 minutes and involved light jogging and dynamic stretching exercises designed to gradually increase heart rate and prepare the muscles for physical activity. The main exercise phase lasted approximately 32 minutes and consisted of continuous running-based aerobic activity performed at a controlled intensity. Each session concluded with a 3-minute cool-down period consisting of light walking and static stretching exercises to facilitate recovery and gradually return heart rate toward resting levels. Exercise intensity was progressively increased during the intervention period to allow physiological adaptation and reduce the risk of injury. During the first four weeks, participants exercised at approximately 60% of their maximum heart rate (HRmax). In weeks five to eight, exercise intensity was increased to 65–70% HRmax, and in the final four weeks (weeks nine to twelve) the intensity reached approximately 75% HRmax. Maximum heart rate was estimated using the standard formula HRmax = 220 − age. Heart rate was monitored during the training sessions using Polar heart rate monitors to ensure that participants maintained the prescribed exercise intensity. Participants assigned to the control group did not participate in the training intervention and continued their usual daily activities without engaging in any additional structured exercise program during the study period.

2.5. Statistical Analysis

Data were analyzed using SPSS version 22. Descriptive statistics including means and standard deviations were calculated for all variables. The Kolmogorov–Smirnov test was used to assess normality of data distribution. Differences between groups were analyzed using analysis of variance (ANOVA). When significant differences were identified, Bonferroni post-hoc tests were applied. Statistical significance was set at $p \leq 0.05$.

3. Findings and Results

Baseline demographic and anthropometric characteristics of the participants are presented in Table 1. The continuous training group and the control group were comparable at baseline, with no statistically significant differences in age, height, weight, or body mass index (BMI) (all $p > 0.05$). These findings indicate that the two groups were relatively homogeneous before the intervention and that any subsequent differences were unlikely to be attributable to baseline inequality.

Table 1

Baseline characteristics of participants

Variable	Continuous Training (n = 10)	Control (n = 10)	p-value
Age (years)	14.89 ± 3.61	14.45 ± 3.06	0.348
Height (cm)	170.93 ± 6.12	171.79 ± 7.30	0.661
Weight (kg)	70.22 ± 10.68	66.72 ± 9.11	0.861
BMI (kg/m²)	22.14 ± 2.24	21.38 ± 1.85	0.838

Before conducting inferential analyses, the normality of the study variables was examined using the Kolmogorov–Smirnov test. As shown in Table 2, height, weight, and body fat were normally distributed in the sample (all $p > 0.05$). Therefore, the use of parametric statistical procedures was considered appropriate.

Table 2

Kolmogorov–Smirnov test for normality

Variable	Statistic	p-value	Distribution
Height	0.557	0.460	Normal
Weight	0.280	0.700	Normal
Body fat	0.445	0.240	Normal

The results of the analysis of variance (ANOVA) for body composition are presented in Table 3. A statistically significant difference was observed between groups with respect to body composition outcomes ($F = 5.77$, $p = 0.002$). This finding indicates that the continuous aerobic training intervention had a significant effect on body composition compared with the control condition.

Table 3

ANOVA results for body composition

Source	Sum of Squares	df	Mean Square	F	p-value
Between groups	575.918	4	191.973	5.77	0.002
Within groups	1918.358	40	47.959		
Total	2494.276	44			

These findings suggest that participation in the 12-week continuous aerobic training program was associated with significant improvement in body composition indices relative to the control group.

4. Discussion

The aim of the present study was to evaluate the effects of continuous aerobic training on body composition in primary school boys. The results demonstrated that participation in a 12-week continuous aerobic training program significantly improved body composition compared with the control group. Participants in the training group showed reductions in body fat percentage and improvements in lean body mass. These findings are consistent with previous research indicating that aerobic exercise can significantly improve body composition and metabolic health in children (1). Aerobic exercise increases energy expenditure and stimulates lipid metabolism, leading to reductions in body fat accumulation (11). In addition, aerobic training enhances mitochondrial density and oxidative enzyme activity in skeletal muscles, which increases the body's capacity to utilize fatty acids as an energy source (10). School-based exercise programs represent an effective approach for increasing physical activity levels among children. Because children spend a large proportion of their time in school environments, structured exercise programs implemented within schools can significantly contribute to improved health outcomes (13). Regular physical activity during childhood is particularly important because early lifestyle habits often persist into adulthood. Promoting physical activity during childhood can therefore play an important role in preventing chronic diseases later in life (2). The findings of the present study are also consistent with research demonstrating that moderate-intensity continuous aerobic training is effective in improving body composition and cardiorespiratory fitness among youth (12). However, several limitations should be considered. The relatively small sample size may limit the generalizability of the findings. Additionally, dietary intake was not controlled during the intervention period, and nutritional factors may influence body composition outcomes. Future research should include larger sample sizes and investigate the combined effects of exercise and nutritional interventions on body composition in children.

5. Conclusion

The results of this study indicate that continuous aerobic training significantly improves body composition in primary school boys. After 12 weeks of training, participants showed reductions in body fat percentage and improvements in lean body mass compared with the control group. These findings highlight the importance of implementing structured aerobic exercise programs within school physical education curricula to promote physical health and prevent childhood obesity.

Authors' Contributions

Reza Omidi Ghanbari contributed to the study design, data collection, training supervision, statistical analysis, interpretation of results, and manuscript preparation.

Declaration

AI-assisted tools (including large language models) were used to support English-language editing and clarity of presentation. The authors reviewed, edited, and verified all content and take full responsibility for the accuracy, integrity, and originality of the final manuscript. No AI tool was used to generate or manipulate the study data, analyses, or results.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

The study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from parents or guardians prior to participation.

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