Impact of school-based exercises on physical fitness outcomes among sedentary high school boys in Vinh city, Vietnam

Impacto de los ejercicios escolares en los resultados de la condición física de los estudiantes varones sedentarios de secundaria en la ciudad de Vinh, Vietnam

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Abstract

Introduction: Sedentary lifestyles increasingly threaten the health of children and adolescents. The purpose of this study is to assess the impact of school-based exercises on the physical fitness outcomes among sedentary high school boys.
Methodology: Eighty volunteers were randomly assigned to either an exercise group or a control group, with 40 participants in each. For three months, the exercise group engaged in three-weekly, 45-minute sessions (warm-up, exercises, cool-down). The control group maintained standard physical education classes.
Results: ANOVA demonstrated highly significant ($p < 0.001$) post-intervention differences between the exercise and control groups, with the exercise group exhibiting better performance in all physical fitness tests: sit-ups, standing long jump, 30m sprint, 4x10m shuttle run, and 5-minute run.
Conclusion: The three-month school-based exercise intervention led to substantial improvements in the exercise group's physical fitness, as evidenced by enhanced abdominal strength and endurance, leg power, speed, agility, and cardiovascular endurance. .

Keywords

Physical activity; physical exercise; physical fitness; school boys; Vietnam.

Resumen

Introducción: Los estilos de vida sedentarios representan una amenaza creciente para la salud de niños y adolescentes. El objetivo de este estudio es evaluar el impacto de los ejercicios escolares en los resultados de la condición física de los estudiantes varones sedentarios de secundaria.
Metodología: Ochenta voluntarios fueron asignados aleatoriamente a un grupo de ejercicio o a un grupo de control, con 40 participantes en cada uno. Durante tres meses, el grupo de ejercicio realizó sesiones de 45 minutos tres veces por semana (calentamiento, ejercicios y enfriamiento). El grupo de control continuó con las clases estándar de educación física.
Resultados: El análisis ANOVA mostró diferencias altamente significativas ($p < 0.001$) entre el grupo de ejercicio y el grupo de control después de la intervención. El grupo de ejercicio presentó un mejor desempeño en todas las pruebas de condición física: abdominales, salto de longitud desde posición estática, sprint de 30 metros, carrera de ida y vuelta de 4x10 metros y carrera de 5 minutos.
Conclusiones: La intervención basada en ejercicios escolares durante tres meses resultó en mejoras sustanciales en la condición física del grupo de ejercicio, evidenciadas en el fortalecimiento y resistencia abdominal, potencia de las piernas, velocidad, agilidad y resistencia cardiovascular.

Palabras clave

Actividad física; ejercicio físico; condición física; estudiantes varones; Vietnam.

Introduction

Physical inactivity is a major cause of noncommunicable disease mortality, increasing the risk of death by 20-30% compared to sufficient activity (World Health Organization, 2024). In Vietnam, 73% of deaths in 2016 from non-communicable diseases were attributed to dietary risks, tobacco use, alcohol consumption, and physical inactivity (World Health Organization, 2017). Recent study revealed that 31% of global adults (1.8 billion) are physically inactive, failing to meet the 150-minute weekly activity recommendation, a 5% increase since 2010. Projections indicate this will rise to 35% by 2030 (Strain et al., 2024). Lack of physical activity and unbalanced diets among children and adolescents result in overweight and obesity, leading to health problems and reduced quality of life (Damian, Oltean, & Damian, 2018). Physical inactivity remains a significant issue for Vietnamese adolescents. Data reveals that approximately 87% failed to meet activity recommendations in both 2001 and 2016 (Guthold, Stevens, Riley, & Bull, 2020), and in 2013, only 19.7% of 13-17 year olds were adequately active (6), demonstrating a consistent lack of progress (World Health Organization, 2013).

Sedentary lifestyles pose a growing health risk for children and adolescents (Król, Nowiński, Mazurkiewicz, Sak, & Fus-Mazurkiewicz, 2024). Globally, 23% of adults and 81% of adolescents (11-17 years) are insufficiently active, failing to meet recommended physical activity levels. Inactivity rates vary significantly across populations, reaching 80% in some adult groups, and increase with economic development due to factors like changing transportation, technology use, urbanization, and cultural values (World Health Organization, 2018). Research indicates that sedentary behaviours, independent of physical activity, are linked to increased cardio-metabolic disease risk, mortality, and various physiological and psychological issues (Tremblay et al., 2011). Study revealed that children spend a large amount of their time sedentary (Hidding, Altenburg, van Ekris, & Chinapaw, 2017) and it is reported that children spend approximately 80% of their day engaged in sedentary behaviours (Murtagh, Hegarty, Mair, Kirby, & Murphy, 2016). Evidence suggests that Vietnamese children and adolescents have low physical activity levels and high levels of sedentary behaviors (Nguyen et al., 2023). Notably, exceeding two hours of daily TV viewing is consistently associated with negative physical and psychosocial health outcomes. For children and adolescents, sedentary leisure activities like TV viewing are linked to metabolic risk factors, regardless of their physical activity levels (Ekelund et al., 2006). Evidence suggested that Vietnamese children and adolescents display an unhealthy imbalance of low physical activity and high sedentary behaviour (Nguyen et al., 2023).

Early involvement in sports and physical activities plays a crucial role in the development of motor skills, the promotion of health, and the enhancement of academic performance, particularly among children and adolescents (Jakiwa et al., 2022). Physical exercise significantly boosts physical fitness and well-being, enhancing executive functions (Zhang, Garnier, Qian, & Li, 2023). Regular activity, including play and sports, yields substantial health benefits by directly and indirectly mitigating major risk factors like hypertension, high cholesterol, obesity, and stress (World Health Organization, 2003). Physical activity significantly influences both physical and mental health, reducing the risk and progression of chronic diseases, enhancing well-being, and positively impacting communities (Kruk, 2009). Engaging in regular physical activity yields significant health benefits, such as enhanced cardiorespiratory fitness, improved body composition, a healthier cardiometabolic profile, and better mental health (World Health Organization, 2020). Physical activity is essential for health. It prevents chronic diseases and premature death (Warburton, Nicol, & Bredin, 2006) Daily exercise reduces stress, improves mood, strengthens the body, and enhances cognitive function, leading to a better life (Mohamemed Abou Elmagd, 2016; Strong et al., 2005). To mitigate the health risks associated with sedentary behaviour, this study investigated the impact of specific physical exercises on improving the physical health outcomes of sedentary high school boys.

Method

Participants

The study sample included 80 fifteen-year-old male high school students from Vinh City, Vietnam, recruited voluntarily and randomly divided into an exercise group and a control group, each with 40 par-

ticipants. To ensure unbiased group allocation, participants were randomly assigned to either an exercise intervention group or a control group. Before enrollment, all participants provided written informed consent and comprehensive health history reports. To maintain study validity and participant safety, individuals with chronic pediatric diseases or orthopedic conditions that would directly limit their ability to complete the exercise program were excluded. .

Procedure

The exercise group engaged in a three-month program, training three times per week for 45 minutes (including warm-up, main activity, and cool-down) outside of school hours. Meanwhile, the control group continued their regular school physical education classes without participating in any additional exercise programs. Both groups underwent pre- and post-intervention testing conducted by the same instructors, following identical procedures and using the same equipment. The specific physical exercises included in this study are detailed in Table 1.

Table 1. Selected physical exercises

Exercises	Purpose	Intensity and volume of exercise
30m high start running	Acceleration, speed	3-5 sets, rest 1min between sets
100m running	Acceleration, speed	3-5 sets, rest 2min between sets
60m running	Acceleration, speed	3-5 sets, rest 1min between sets
Standing long jump	Leg power	perform to the best of ability
Standing high jump	Leg power	perform to the best of ability
Sit up	Abdominal muscular strength	3 - 5 sets, 15-20 times each set, 15s rest between sets.
Back extension exercise (prone)	Abdominal and back muscular strength	perform to the best of ability
Plank	Strength of arms, abdomen	3 sets, 20-30s each set, 15s rest between sets.
High knee jump	Leg power	3-5 sets, 15s for each set, 30s rest between sets
Squats	Leg power	3 sets of 20 reps
800m running	Aerobic and anaerobic power	1 time for each training section (substitute for 5-minute free running)
5-minute free running	Aerobic and anaerobic power	1 time for each training section (substitute for 800m running)
30m zigzag running	Speed, body control and agility	3-5 sets, 30s rest for each time
30m shuttle running	Speed, body control and agility	3-5 sets, 30s rest for each time

Reps: repetitions; min: minute; s: second

Intervention and protocol

Pre-test: On October 4, 2024, a pre-test was administered to the 80 participants. A 12-week training program was then developed, based on established scientific literature, and implemented from October 7, 2024, to January 5, 2025. This program consisted of three 45-minute training sessions per week.
Post-test: Following the completion of the training program on January 5, 2025, a post-test was conducted on the same participants, utilizing identical testing procedures, conditions, order, and timing as the pre-test.

Outcomes measurements

Test 1: 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 (R. Wood, 2008). Test 2: Standing long jump (cm): to measure the explosive power of the legs (Mackenzie, 2000). Test 3: 30 meter sprint (s): to determine acceleration and speed (R. Wood, 2008b). Test 4: 4x10m shuttle running (s): test of speed, body control and the ability to change direction (agility) (R. Wood, 2008a). Test 5: 5-minute running (m): to measure the endurance (Berthon et al., 1997).

Data analysis

Statistical analyses of the study were performed in SPSS package program. Data normality was confirmed by the Kolmogorov-Smirnov test ($P > 0.05$). Significance was determined at a p-value of 0.05 or lower. Data are reported as means with standard deviations. Paired t-tests were used to evaluate within-group changes, while ANOVA was employed to compare between-group differences in pre-test and post-test data.

Results

Changes in the performance of tests between Exercise and Control groups

Table 2. Tests performance control groups at pre-test and post-test

Tests	Pre-test		Post-test		Sig*. (2-tailed)
	Mean	SD	Mean	SD	
Sit up (times/30s)	15.80	1.94	15.72	1.88	0.372
Standing long jump (cm)	191.98	6.47	192.23	7.67	0.318
30m sprint test (s)	6.28	0.12	6.30	0.11	0.146
4x10m shuttle running (s)	12.99	0.25	13.00	0.25	0.066
5-minute running (m)	897.90	20.21	898.15	20.30	0.323

*Paired samples t- test; SD: Standard Deviation

No significant differences were observed in physical fitness tests within the control group between pre-test and post-test assessments (Table 2). Paired samples t-tests revealed no statistically significant differences for any of the tests ($p > 0.05$).

Table 3. Tests performance of exercise group at pre-test and post-test

Tests	pre-test		post-test		Sig*. (2-tailed)
	Mean	SD	Mean	SD	
Sit up (times/30s)	15.45	1.93	19.55	1.82	0.000
Standing long jump (cm)	191.15	7.14	209.75	7.78	0.000
30m sprint test (s)	6.23	0.14	5.01	0.21	0.000
4x10m shuttle running (s)	12.89	0.21	12.08	0.27	0.000
5-minute running (m)	911.02	29.40	996.50	30.06	0.000

*Paired samples t- test; SD: Standard Deviation

Table 3 reveals that the exercise group exhibited highly significant improvements ($p < 0.000$) in all measured physical fitness test scores from pre-test to post-test. Paired t-tests confirmed robust within-group enhancements across all tested parameters.

Table 4. Means of physical tests between exercise and control groups at pre-test

Tests	Exercise group		Control group		F	Sig.*
	Mean	SD	Mean	SD		
Sit up (times/30s)	15.45	1.93	15.80	1.92	0.658	0.420
Standing long jump (cm)	191.15	7.14	191.98	6.47	0.293	0.590
30m sprint test (s)	6.32	0.46	6.28	6.78	2.103	0.151
4x10m shuttle running (s)	12.89	0.27	12.99	0.25	2.347	0.130
5-minute running (m)	911.02	29.40	897.90	20.21	5.411	0.023

* Anova; SD: Standard Deviation.

As shown in Table 4, the exercise and control groups exhibited no statistically significant differences at pre-test in standing long jump (lower extremity strength), sit-ups (abdominal strength), 30m sprint (speed), 4x10m shuttle run (body control), except 5-minute run has slight difference.

Table 5. Means of physical tests between exercise and control groups at post-test

Tests	Exercise group		Control group		F	Sig.*
	Mean	SD	Mean	SD		
Sit up (times/30s)	19.55	1.82	15.72	1.88	85.203	0.000
Standing long jump (cm)	209.75	7.78	192.38	7.67	100.443	0.000
30m sprint test (s)	5.19	0.21	6.28	0..12	746.431	0.000
4x10m shuttle running (s)	12.08	0.32	13.00	0.25	199.273	0.000
5-minute running (m)	996.50	30.06	898.15	20.30	293.917	0.000

* Anova; SD: Standard Deviation.

Table 5 presents a detailed comparison of post-test physical fitness test results between the exercise and control groups. The data clearly demonstrates statistically significant differences ($p < 0.001$) across all five measured parameters: sit-ups, standing long jump, 30m sprint, 4x10m shuttle run, and 5-minute

running. These highly significant findings suggest that the three-month intervention period resulted in substantial and consistent improvements in the exercise group's performance. Specifically, the exercise group exhibited significantly enhanced strength in both lower extremities (standing long jump) and abdominal musculature (sit-ups), as well as improved speed (30m sprint), body control/agility (4x10m shuttle run), and cardiovascular endurance (5-minute running) compared to the control group, which did not receive the intervention.

Discussion

This study aimed to evaluate the effectiveness of physical exercises in enhancing the physical fitness of sedentary school boys. Findings reveal a significant improvement in physical fitness among participants. These results demonstrated that school-based exercises effectively enhance abdominal muscular strength and endurance of the abdominals and hip-flexors, explosive power of the legs, acceleration and speed; speed, body control and the agility, cardiovascular endurance following a three month training program incorporating school-based physical exercises.

These findings are consistent with prior research indicating that school-based exercise enhances specific fitness components (Abdelkarim, El-Gyar, Shalaby, & Aly, 2024), yields multiple positive effects on overall physical fitness (Kriemler et al., 2011; Manojlovic et al., 2023; Wu et al., 2023), increase in VO2max after an aerobic exercise intervention in students (Amha, Putri, & Lutfie, 2022; Dobbins, Husson, DeCorby, & LaRocca, 2009). Long-term school-based interventions combined with rigorous theoretical and methodological frameworks are necessary to develop, implement and evaluate physical activity interventions for children and adolescents (Alalawi, Blank, & Goyder, 3023). Additionally, exercise has been shown to improve physical performance coordination and vestibular stability in school children (Polevoy, 2020).

Our findings also align with previous research demonstrating that increased physical activity simultaneously improves physical fitness (Hartati, Hidayat, Wisnu, Prakoso, & Suroto, 2019), enhances muscle strength, endurance, and flexibility in secondary students (Çifçi, 2022), and promotes motor skill development in primary students (Gabriel, Veronica, & Mircea, 2017). Additionally, school-based after-school programs enhance coordination and physical fitness in children (Kurma, Flôres, Altınkök, Esen, & Silva, 2004), and targeted physical activities improve psychomotor and mental functions, including memory, reality perception, and attention (Kuznetsova et al., 2022).

Research has consistently showed the positive impact of physical activity and exercise on children's development and significantly improved bio-motor fitness components (Siby et al., 2024), improve the fitness and physical capacity of the students (Khai & Thuc, 2021). Previous findings proved that early participation in sports and physical activities significantly contributes to the development of motor skills, health, and academic performance, particularly among children and adolescents (Jakiwa et al., 2022), improve physical fitness, particularly aerobic fitness, which has been shown to be a powerful indicator of cardiovascular health in children and adolescents (Ardoy et al., 2011). Furthermore, coordination-focused educational programs effectively enhance basic motor development in preschool children, preparing them for higher education through adequate psychomotor development (Altinkök, 2016). Physical exercises also improve vestibular stability in schoolchildren (Georgiy Polevoy, 2023). Regular leisure-time physical activity is crucial for developing physical abilities in school-aged children, laying the foundation for lifelong physical fitness (Michaela, Elena, Robert, & Janka, 2022).

Conclusions

The study recruited 80 subjects. Participants are high school boys at Vinh city, Vietnam. The three-month school-based exercise intervention led to substantial improvements in the exercise group's physical fitness, as evidenced by enhanced abdominal strength and endurance, leg power, speed, agility, and cardiovascular endurance. To provide more robust comparisons in future research, an exercise control group, potentially involving a home-based program, should be incorporated.

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