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Comparative Analysis of Structured Conditioning on Aerobic Fitness Levels among Secondary School Students

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Abstract

This study aimed to examine the effectiveness of structured conditioning programs in improving aerobic fitness levels among secondary school students aged 14 to15 years. Aerobic fitness, an essential component of physical health and academic performance in adolescents, was assessed using the multistage shuttle run test (beep test), a widely recognized and practical field-based measure of cardiorespiratory endurance. A total of participants were divided into two groups: an experimental group that underwent a structured conditioning program and a control group that followed regular physical education activities. The structured conditioning program consisted of systematically planned and progressively intensified exercises designed to enhance cardiorespiratory endurance over a defined training period. Pre- and post-test assessments were conducted using standardized beep test procedures, which involve continuous running between two markers set 20 meters apart in synchronization with audio signals that gradually increase in speed. To determine the effectiveness of the intervention, the collected data were analyzed using the t-ratio (independent and paired t-test). The results revealed a statistically significant improvement in aerobic fitness levels among students who participated in the structured conditioning program compared to those in the control group. The findings indicate that structured and progressive training methods are more effective in enhancing endurance capacity than conventional physical education practices. In conclusion,

the study highlights the importance of incorporating structured conditioning programs into school physical education curricula to improve aerobic fitness and promote long-term health benefits among adolescents. These results provide valuable insights for educators and curriculum planners aiming to optimize physical fitness outcomes in secondary school settings.

Keywords: Structured conditioning, Aerobic fitness, Multistage shuttle run test, Beep test, Secondary school students

Introduction

Aerobic fitness is a fundamental component of overall health and physical performance, particularly during adolescence, a critical period for growth and development. It reflects the efficiency of the cardiovascular and respiratory systems in supplying oxygen during sustained physical activity. Higher levels of aerobic fitness are associated with improved health outcomes, including reduced risk of cardiovascular diseases, better metabolic functioning and enhanced cognitive performance among school-aged children (Neil Armstrong & Willem van Mechelen, 2008). Consequently, promoting aerobic fitness through school-based physical education programs has become a priority in educational and public health domains.

Structured conditioning programs are widely recognized as an effective approach to improving physical fitness. These programs involve systematically planned exercises with progressive intensity designed to enhance specific fitness components such as endurance, strength and flexibility. Research indicates that structured and supervised training interventions produce significant improvements in aerobic capacity compared to unstructured or routine physical activity (Claude Bouchard *et al*. 2012). In school settings, however, physical education often emphasizes general participation rather than targeted fitness development, which may limit the effectiveness of such programs in improving aerobic endurance.

The multistage shuttle run test, commonly known as the beep test, is one of the most widely used field tests for assessing aerobic fitness in children and adolescents. Developed by Luc Léger and colleagues, this test provides a reliable and practical measure of cardiorespiratory endurance by requiring participants to run back and forth over a 20-meter distance in time with progressively increasing audio signals (Léger *et al*. 1988). Its simplicity, cost-effectiveness and suitability for large groups make it particularly appropriate for school-based assessments.

Despite the recognized importance of aerobic fitness, there is limited empirical evidence comparing the effectiveness of structured conditioning programs with conventional physical education practices among secondary school students. Understanding the relative impact of these approaches is essential for developing evidence-based physical education curricula that optimize both fitness outcomes and student engagement.

Therefore, the present study aims to examine the effect of a structured conditioning program on aerobic fitness levels among secondary school students aged 14 to 15 years. It is hypothesized that students who participate in a structured conditioning program will demonstrate significantly greater improvements in aerobic fitness, as measured by the multistage shuttle run test, compared to those engaged in regular physical education activities.

Materials and Methods

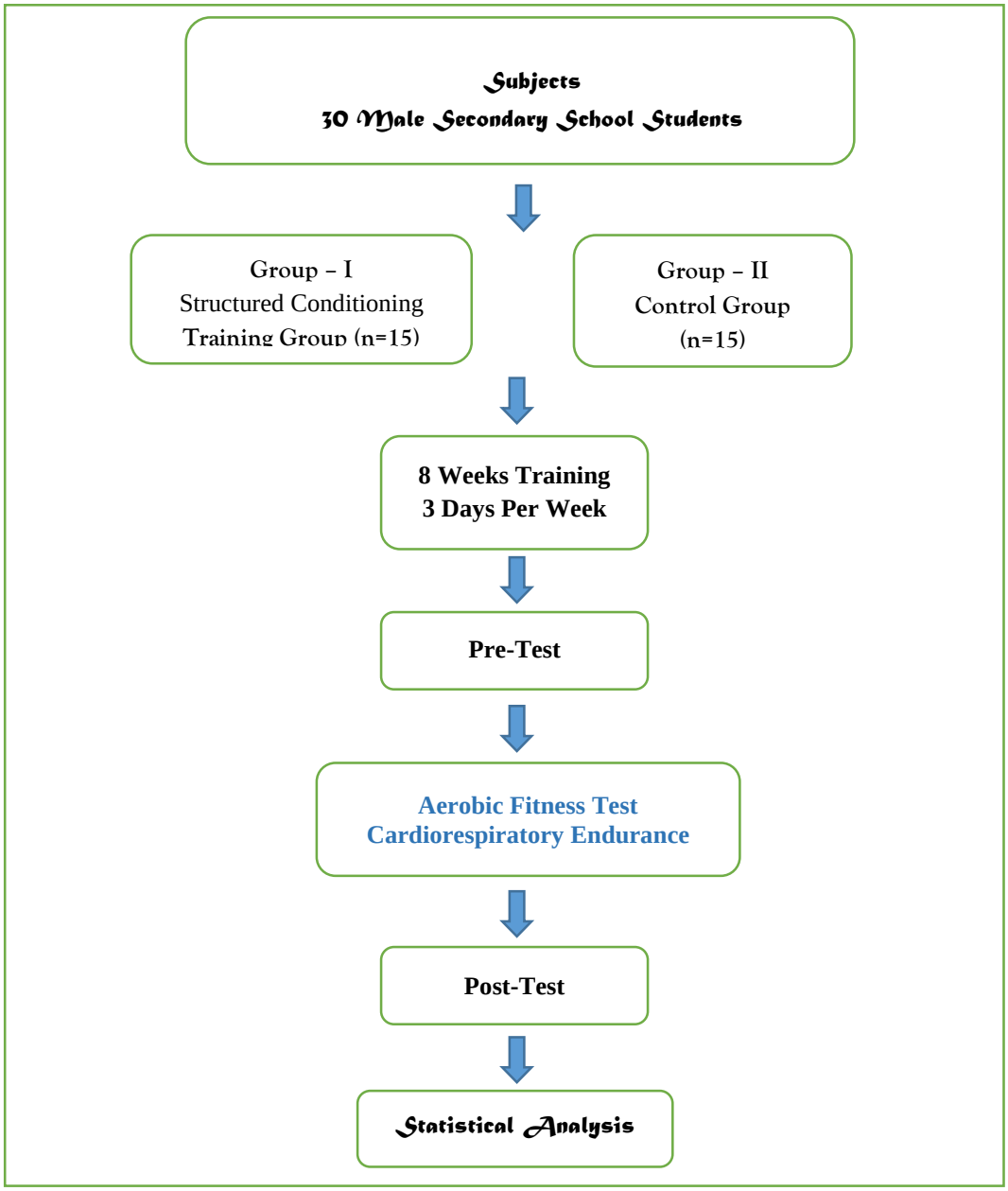
Participants

The study involved 30 secondary school students, with 15 students assigned to each group, aged 14 to 15 years, enrolled at Invictus International School, Cambodia. Participants were selected based on voluntary consent and absence of medical conditions or injuries that could limit physical activity. Parental or guardian consent was also obtained to ensure ethical compliance. The students were randomly assigned into two groups: an experimental group that participated in a structured conditioning program and a control group that continued with routine physical education activities. The random allocation helped minimize bias and ensured comparability between the groups in terms of baseline characteristics such as age, gender, and initial fitness levels.

Experimental Design

The study utilized a pre-test and post-test control group design to evaluate the effect of structured conditioning on aerobic fitness. The experimental group underwent a systematically designed and progressively intensified exercise program aimed at enhancing cardiovascular endurance, while the control group participated in regular physical education sessions without a structured intensity plan. Aerobic fitness was assessed in both groups before and after the intervention using the multistage shuttle run test, commonly known as the beep test. This design allowed for a direct comparison of the effectiveness of structured conditioning relative to standard school physical education, while controlling for external variables that could affect fitness outcomes.

Experimental Design Flow Chart



Training Protocol

The structured conditioning program for the experimental group was implemented over eight weeks, with three sessions per week, each lasting approximately 45 minutes. Each session was divided into three main phases: warm-up, main exercise and cool-down. The warm-up phase, lasting 10 minutes, included dynamic stretching and light jogging to prepare the cardiovascular and musculoskeletal systems for more intense activity. The main exercise phase, lasting 25 minutes, focused on endurance development through interval running, circuit-based exercises and plyometric drills, with progressive increases in intensity over the eight weeks. The cool-down phase, lasting 10 minutes, consisted of static stretching and breathing

exercises to aid recovery and prevent injury. The control group did not participate in any additional structured activity and continued with their usual daily routine, without engaging in specific physical training or exercises designed to enhance aerobic fitness. This comparison allowed the study to isolate the impact of structured conditioning on aerobic fitness.

Measurement of Aerobic Fitness (Beep Test)

Aerobic fitness was measured using the multistage shuttle run test, which is widely recognized for its reliability and practicality in school settings. In this test, two markers were placed 20 meters apart and participants ran continuously between the markers in synchronization with pre-recorded audio signals ("beeps") that gradually increased in frequency. The test continued until participants failed to reach the markers in time with the beeps twice consecutively. The maximum level and shuttle completed were recorded as an indicator of cardiorespiratory endurance. This method is particularly suitable for adolescent populations because it allows assessment of large groups simultaneously, requires minimal equipment and provides an objective measure of aerobic capacity.

Statistical Analysis

Data were analyzed using SPSS Version 20. Descriptive statistics, including mean and standard deviation, were calculated for all pre-test and post-test scores. To evaluate the effectiveness of the structured conditioning program, the t-ratio was calculated to compare aerobic fitness scores within the experimental group from pre-test to post-test, as well as to compare post-test scores between the experimental and control groups. A significance level of $p < 0.05$ was used to determine whether the observed differences were statistically meaningful. This approach allowed for a clear assessment of the impact of structured conditioning on aerobic fitness while quantifying the magnitude of differences between and within groups.

Table I: Pre and Post-Test Comparison of Cardiorespiratory Endurance (Beep Test) Between Experimental and Control Groups

S. No.	Variables	Group	Pre-Test Mean (± SD)	Post-Test Mean (± SD)	t	p
1	Cardiorespiratory Endurance (Beep Test)	Experimental Group	6.23 ± 1.82	7.04 ± 2.14	**3.34**	0.005
		Control Group	5.87 ± 1.93	5.72 ± 1.62	**0.74**	0.472

Significant at p < 0.05.

The experimental group demonstrated a notable improvement in beep test performance, with mean scores increasing from 6.23 ± 1.82 at pre-test to 7.04 ± 2.14 at post-test. A paired t-test indicated that this improvement was statistically significant **(**t = 3.34, p = 0.005**)**. In contrast, the control group showed a slight decrease in mean scores from 5.87 ± 1.93 to 5.72 ± 1.62, which was not statistically significant **(**t = 0.74, p = 0.472**)**. These results suggest that the structured conditioning intervention effectively enhanced cardiorespiratory endurance compared to regular game-based PE activities.

Discussion

The study demonstrated that a structured conditioning program significantly enhanced aerobic fitness among secondary school students compared to regular game-based physical education. The findings indicate that targeted and systematically designed exercise interventions are more effective in improving cardiorespiratory endurance than unstructured or recreational activities. The structured conditioning program likely produced these improvements due to its organized approach, incorporating interval running, muscular endurance exercises, speed and agility drills and plyometric activities. The progressive intensity and clearly defined objectives of the program provided a consistent aerobic stimulus, facilitating cardiovascular and muscular adaptations in adolescents. In contrast, students participating in game-based physical education activities showed minimal improvement in aerobic fitness. While recreational games are beneficial for motivation, engagement and skill development, they may not consistently provide the intensity or duration required to produce meaningful changes in cardiorespiratory endurance.

These results highlight the importance of integrating structured conditioning into school-based physical education. By combining targeted fitness training with enjoyable activities, educators can enhance students' aerobic capacity while maintaining engagement and promoting long-term health benefits. The findings support previous research emphasizing that systematic and progressively intensified training interventions yield greater improvements in adolescent cardiorespiratory fitness compared to unstructured activity (Bouchard *et al*. 2012; Léger *et al*. 1988).

Conclusion

The study indicates that structured conditioning programs are more effective than regular game-based physical education in enhancing aerobic fitness among secondary school

students. Targeted exercises with progressive intensity and clearly defined objectives provide a consistent stimulus that promotes improvements in cardiorespiratory endurance. In contrast, unstructured or recreational activities, while engaging, may not offer sufficient intensity to achieve significant aerobic gains.

These findings suggest that integrating structured conditioning into school physical education curricula can support the development of cardiovascular fitness in adolescents while maintaining student motivation and participation. Implementing such programs may contribute to improved health outcomes and overall physical performance in the school-aged population.

Recommendations

Based on the findings of this study, it is recommended that schools integrate structured conditioning exercises into physical education curricula to enhance aerobic fitness among secondary school students. Programs should include progressive training with clearly defined intensity levels and targeted exercises such as interval running, endurance circuits, agility drills and plyometric activities to provide consistent cardiovascular stimulus. Combining structured conditioning with game-based activities can maintain student engagement while promoting measurable improvements in cardiorespiratory endurance. Regular assessment of aerobic fitness, using practical tools such as the beep test, is encouraged to monitor progress and guide adjustments in training intensity. Additionally, future research should explore longer intervention durations, higher training frequencies and larger, more diverse student populations, while incorporating physiological measurements such as VO_2 max or heart rate recovery to gain deeper insights into cardiovascular adaptations.

References

Armstrong, N., & van Mechelen, W. (2008). Paediatric exercise science and medicine. Oxford University Press.

Armstrong, N., & Welsman, J. (2019). Aerobic fitness in youth: Measurement, interpretation, and implications. *Journal of Sports Sciences*, 37(12), 1382–1389.

Baquet, G., Berthoin, S., Gerbeaux, M., & Van Praagh, E. (2010). High-intensity interval training improves aerobic fitness in children and adolescents. *Journal of Sports Science & Medicine*, 9(2), 127–134.

Bouchard, C., Blair, S. N., & Haskell, W. L. (2012). Physical activity and health (2nd ed.). Champaign, IL: Human Kinetics.

Buchan, D. S., Ollis, S., Thomas, N. E., & Baker, J. S. (2011). Physical activity behaviour and aerobic fitness in secondary school students. *Preventive Medicine*, 52(6), 408–410.

Chen, W., Hammond-Bennett, A., & Lyons, E. (2018). Effects of structured physical education on adolescent aerobic capacity. *Journal of Physical Activity and Health*, 15(3), 169–176.

Faigenbaum, A. D., Kraemer, W. J., Blimkie, C. J., Jeffreys, I., Micheli, L. J., Nitka, M., & Rowland, T. W. (2009). Youth resistance training: Updated position statement. *Journal of Strength and Conditioning Research*, 23(5 Suppl), S60–S79.

Léger, L. A., & Lambert, J. (1982). A maximal multistage 20-m shuttle run test to predict VO_2 max. *European Journal of Applied Physiology and Occupational Physiology*, 49(1), 1–12.

Léger, L. A., Mercier, D., Gadoury, C., & Lambert, J. (1988). The multistage 20 metre shuttle run test for aerobic fitness. *Journal of Sports Sciences*, 6(2), 93–101.

Milanović, Z., Sporiš, G., & Weston, M. (2015). High-intensity interval training versus continuous training: Effects on VO_2 max. *Sports Medicine*, 45(10), 1469–1481.

Ortega, F. B., Ruiz, J. R., Castillo, M. J., & Sjöström, M. (2008). Physical fitness in youth: A powerful marker of health. *International Journal of Obesity*, 32(1), 1–11.

Tomkinson, G. R., Lang, J. J., & Tremblay, M. S. (2017). Shifting the paradigm of aerobic fitness assessment in youth. *British Journal of Sports Medicine*, 51(17), 1251–1252.