



Effects of circuit training and Indian traditional games on cardiovascular endurance and flexibility among school students: An experimental study

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Abstract

This study compared the effects of circuit training and Indian traditional games on cardiovascular endurance and flexibility among school students. Sixty students were randomly assigned to a Circuit Training Group (CTG, $n = 20$), Indian Traditional Games Group (ITGG, $n = 20$), or Control Group (CG, $n = 20$). The experimental groups participated in 12-week programmes, three sessions per week. Cardiovascular endurance was assessed using the 600-yard Run Test and flexibility using the Sit-and-Reach Test. ANCOVA was used to analyse post-test differences at $p < .05$. The results showed that the CTG achieved the greatest improvements in both cardiovascular endurance and flexibility, indicating that circuit training is highly effective for enhancing these components of physical fitness among school students.

Keywords: Circuit training, Indian traditional games, cardiovascular endurance, flexibility, physical fitness, school students, 600-yard run test, sit-and-reach test, experimental study, ANCOVA

Introduction

Cardiovascular endurance and flexibility are essential components of health-related physical fitness that contribute to efficient body movement, improved functional performance, and the prevention of lifestyle-related diseases during childhood. Schools provide an ideal environment for implementing structured physical activity programmes that enhance these fitness components. Circuit training is widely recognized for improving aerobic capacity and flexibility through systematic and progressive exercises, whereas Indian traditional games promote continuous movement, agility, and active participation within a culturally meaningful context.

Although both approaches have demonstrated positive effects on physical fitness, limited research has directly compared their effectiveness in improving cardiovascular endurance and flexibility among school students. Therefore, the present study aimed to compare the effects of a 12-week circuit training programme and an Indian traditional games programme on cardiovascular endurance and flexibility. It was hypothesized that both interventions would improve these fitness components compared with the control group, with circuit training producing greater improvements.

Objectives

General Objective

To compare the effects of a 12-week circuit training programme and an Indian traditional games programme on cardiovascular endurance and flexibility among school students.

Specific Objectives

- To determine the effect of a circuit training programme on cardiovascular endurance and flexibility among school students.
- To determine the effect of an Indian traditional games programme on cardiovascular endurance and flexibility among school students.

- To compare the effectiveness of circuit training and Indian traditional games in improving cardiovascular endurance and flexibility among school students.

Research Hypotheses

- A 12-week circuit training programme will significantly improve cardiovascular endurance among school students compared with the control group.
- A 12-week Indian traditional games programme will significantly improve cardiovascular endurance among school students compared with the control group.
- There will be a statistically significant difference between the effects of circuit training and Indian traditional games on cardiovascular endurance among school students.
- A 12-week circuit training programme will significantly improve flexibility among school students compared with the control group.
- A 12-week Indian traditional games programme will significantly improve flexibility among school students compared with the control group.
- There will be a statistically significant difference between the effects of circuit training and Indian traditional games on flexibility among school students.

Materials and Methods

1. Research Design

The present study employed a true experimental pre-test–post-test control group design to investigate the effects of circuit training and Indian traditional games on cardiovascular endurance and flexibility among school students. The study included three groups: The Circuit Training Group (CTG), the Indian Traditional Games Group (ITGG), and the Control Group (CG). Pre-test and post-test assessments were conducted to evaluate the effectiveness of the intervention programmes.

2. Participants

A total of 60 school students aged 12–14 years were selected from Vadodara, Gujarat, using a random sampling technique. The participants were randomly assigned into three equal groups (n = 20 each): Circuit Training Group (CTG), Indian Traditional Games Group (ITGG), and Control Group (CG).

3. Intervention Programme

The intervention was conducted for 12 weeks, with three training sessions per week. The Circuit Training Group participated in a structured circuit training programme consisting of progressive exercise stations designed to improve cardiovascular endurance and flexibility. The Indian Traditional Games Group participated in selected traditional games, including Kho Kho, Kabaddi, Langdi, and Satoliya, which involved continuous movement, agility, and dynamic body actions. The Control Group continued their regular school physical education activities without participating in the intervention programmes.

4. Variables

Independent Variable

- Circuit Training Programme
- Indian Traditional Games Programme
- Control Group

Dependent Variables

- Cardiovascular Endurance
- Flexibility

5. Criteria of Measurement

Cardiovascular Endurance

Cardiovascular endurance was assessed using the 600-Yard Run Test, a standardized field test commonly used to evaluate aerobic endurance among school students.

Participants were instructed to complete the 600-yard distance in the shortest possible time. The total time taken to complete the test was recorded in minutes, with lower completion times indicating better cardiovascular endurance.

Flexibility

Flexibility was measured using the Sit-and-Reach Test, which is a widely accepted assessment of hamstring and lower back flexibility. Participants sat with their legs fully extended and reached forward along a standardized measuring box as far as possible without bending their knees. The best of two trials was recorded in centimetres (cm), with higher scores indicating greater flexibility.

Table 5.1: Criteria of Measurement

Variable	Test	Unit
Cardiovascular Endurance	600-Yard Run Test	Minutes
Flexibility	Sit-and-Reach Test	Centimetres (cm)

6. Data Collection Procedure

Pre-test assessments were conducted before the commencement of the intervention using standardized testing procedures. Following the pre-test, participants were randomly assigned to one of the three study groups. The intervention programmes were implemented for 12 weeks, with training sessions conducted three times per week. Upon completion of the intervention, post-test assessments were administered using the same testing protocols and equipment employed during the pre-test. All measurements were recorded systematically under similar testing conditions to ensure consistency. The collected data were coded and analysed using descriptive statistics and ANCOVA to determine the effectiveness of the intervention programmes.

Results

Cardiovascular Endurance

Table 1: Descriptive Statistics for Cardiovascular Endurance

Group	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean Difference
Circuit Training Group (CTG)	20	2.49	0.09	2.34	0.09	–0.15
Indian Traditional Games Group (ITGG)	20	2.50	0.07	2.45	0.07	–0.05
Control Group (CG)	20	2.49	0.08	2.49	0.08	0.00

Note: Values are presented as mean and standard deviation (SD) for the pre-test and post-test 600-yard run scores. Lower completion times indicate better cardiovascular endurance. CTG = Circuit Training Group; ITGG = Indian Traditional Games Group; CG = Control Group; SD = Standard Deviation.

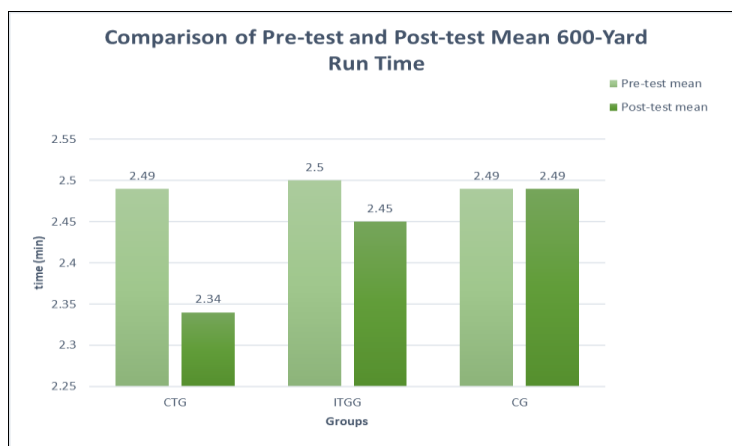


Fig 1: Comparison of Pre-test and Post-test Mean 600-Yard Run Time

Table 1 presents the descriptive statistics for cardiovascular endurance among the three study groups. The Circuit Training Group (CTG) demonstrated the greatest improvement, with the mean 600-yard run time decreasing from 2.49 ± 0.09 minutes at pre-test to 2.34 ± 0.09 minutes at post-test (mean difference = -0.15 minutes). The Indian

Traditional Games Group (ITGG) also showed improvement, with the mean time decreasing from 2.50 ± 0.07 minutes to 2.45 ± 0.07 minutes (mean difference = -0.05 minutes). In contrast, the Control Group (CG) showed no change between the pre-test and post-test assessments.

Table 2: Analysis of Covariance (ANCOVA) for Cardiovascular Endurance

Source	df	Mean Square (MS)	F-ratio	Sig.
Between Groups	2	24.073	501.50	$p < .001$
Error	56	0.048	—	—

Note: ANCOVA was performed using pre-test cardiovascular endurance scores as the covariate. A statistically significant difference was observed among the three groups ($F(2, 56) = 501.50, p < .001$).

The ANCOVA results presented in Table 2 revealed a statistically significant difference among the three groups after controlling for pre-test cardiovascular endurance scores ($F = 501.50, p < .001$). These findings indicate that

the intervention programmes significantly influenced cardiovascular endurance, with the Circuit Training Group demonstrating superior improvement compared with the Indian Traditional Games Group and the Control Group.

Flexibility

Table 3: Descriptive Statistics for Flexibility

Group	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean Improvement
Circuit Training Group (CTG)	20	8.40	1.79	10.10	1.94	+1.70
Indian Traditional Games Group (ITGG)	20	8.50	1.73	8.85	1.63	+0.35
Control Group (CG)	20	8.70	1.75	8.70	1.75	0.00

Note: Values are presented as mean and standard deviation (SD) for the pre-test and post-test flexibility scores. Higher scores indicate better flexibility as measured by the Sit-and-Reach Test. CTG = Circuit Training Group; ITGG = Indian Traditional Games Group; CG = Control Group; SD = Standard Deviation.

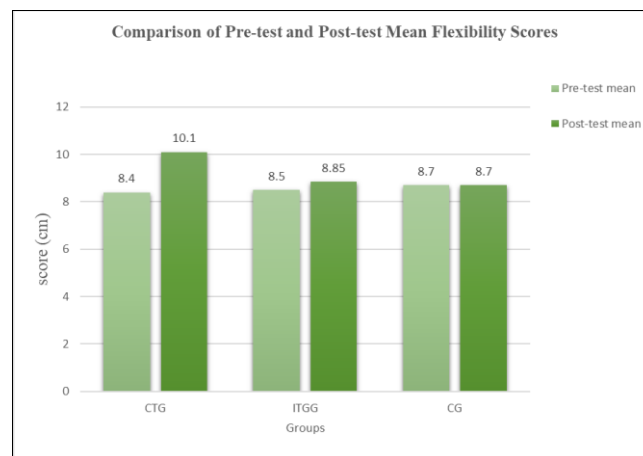


Fig 2: Comparison of Pre-test and Post-test Mean Flexibility Scores

Table 3 presents the descriptive statistics for flexibility among the three study groups. The Circuit Training Group (CTG) exhibited the greatest improvement, with the mean flexibility score increasing from 8.40 ± 1.79 cm at pre-test to 10.10 ± 1.94 cm at post-test (mean improvement = 1.70 cm). The Indian Traditional Games Group (ITGG) showed a modest improvement from 8.50 ± 1.73 cm to 8.85 ± 1.63 cm (mean improvement = 0.35 cm), whereas the Control Group (CG) showed no improvement.

Table 4: Analysis of Covariance (ANCOVA) for Flexibility

Source	df	Mean Square (MS)	F-ratio	Sig.
Between Groups	2	17.937	102.67	$p < .001$
Error	56	0.175	—	—

Note: ANCOVA was performed using pre-test flexibility scores as the covariate. A statistically significant difference was observed among the three groups ($F(2, 56) = 102.67, p < .001$).

The ANCOVA results presented in Table 4 indicated a statistically significant difference among the three groups after adjusting for pre-test flexibility scores ($F = 102.67, p < .001$). These findings suggest that the intervention programmes had a significant effect on flexibility, with the Circuit Training Group showing the greatest improvement, followed by the Indian Traditional Games Group, while the Control Group demonstrated no meaningful change.

Discussion

The present study compared the effects of circuit training and Indian traditional games on cardiovascular endurance and flexibility among school students. The findings indicated that both intervention programmes significantly improved these fitness components compared with the control group. However, the Circuit Training Group (CTG) demonstrated significantly greater improvements than the

Indian Traditional Games Group (ITGG). The significant ANCOVA results for cardiovascular endurance ($F = 501.50$, $p < .001$) and flexibility ($F = 102.67$, $p < .001$) confirmed the effectiveness of the intervention programmes.

The greater improvement observed in the Circuit Training Group may be attributed to the structured, progressive, and systematic nature of circuit training, which provides an optimal stimulus for enhancing aerobic capacity and joint flexibility. These findings are consistent with previous studies that reported significant improvements in cardiovascular endurance and flexibility following circuit training programmes among school-aged children (Peralta *et al.*, 2020; Wu *et al.*, 2023) [5, 8]. Although the Indian Traditional Games Group exhibited comparatively smaller improvements, the results suggest that traditional games can effectively enhance physical fitness while promoting enjoyment, active participation, and cultural values within school physical education.

Overall, the findings suggest that circuit training is a more effective strategy for improving cardiovascular endurance and flexibility among school students. Nevertheless, Indian traditional games remain a valuable and culturally appropriate approach that can complement structured fitness programmes and contribute to holistic physical development.

Conclusion

The findings of the present study demonstrate that both circuit training and Indian traditional games are effective in improving cardiovascular endurance and flexibility among school students. However, the Circuit Training Programme produced significantly greater improvements than the Indian Traditional Games Programme, indicating that a structured and progressive training approach is more effective in enhancing these components of physical fitness.

Although circuit training proved to be the superior intervention, Indian traditional games also resulted in significant improvements compared with the control group. These findings highlight the potential of Indian traditional games as an enjoyable, culturally relevant, and cost-effective strategy for promoting physical fitness in school settings. Therefore, integrating circuit training with Indian traditional games in school physical education programmes may provide a balanced approach to improving students' cardiovascular endurance, flexibility, and overall physical well-being.

Practical Implications

- Circuit training can be adopted as an effective and time-efficient method for improving cardiovascular endurance and flexibility in school physical education programmes.
- Indian traditional games provide a low-cost, enjoyable, and culturally relevant approach to enhancing physical fitness while increasing student participation.
- Physical education teachers are encouraged to integrate circuit training with Indian traditional games to improve students' fitness, motivation, and lifelong participation in physical activity.

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