

Speed Endurance Responses to Tempo and Intermittent Running Training in University-Level Male Students

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Abstract—The purpose of the study was to compare the effects of tempo running and intermittent running training on selected speed endurance variables among university men students. Forty-five male university students aged 18–25 years were randomly assigned into three groups: tempo running group (TRG, n = 15), intermittent running group (IRG, n = 15), and control group (CG, n = 15). The experimental groups underwent their respective training programmes for eight weeks, three sessions per week, while the control group followed regular physical activity without specialized training. Speed endurance was assessed using a 150-metre run test. Analysis of covariance (ANCOVA) was applied to determine significant differences among the groups at the 0.05 level of confidence. The results revealed significant improvements in speed endurance for both experimental groups compared to the control group. Furthermore, intermittent running training produced significantly greater improvement in speed endurance than tempo running training. The findings suggest that intermittent running training is more effective for enhancing speed endurance among university men students.

Keywords: Tempo running, Intermittent running, Speed endurance, University men, Training adaptation

I. INTRODUCTION

Speed endurance is a critical physical fitness component required in many sports that involve repeated high-intensity efforts over extended durations, such as athletics, football, hockey, and basketball. It refers to the ability to maintain near-maximal speed despite the onset of fatigue. Developing speed endurance is therefore a key objective in conditioning programmes for university-level athletes. Among various training methods, tempo running and intermittent running are widely used to enhance speed endurance. Tempo running involves sustained running at sub-maximal intensity, improving aerobic efficiency and lactate threshold. In contrast, intermittent running consists of repeated bouts of high-intensity running interspersed with recovery periods, targeting both aerobic and anaerobic energy systems. Although both methods are commonly prescribed, limited comparative evidence exists regarding their relative effectiveness on speed endurance among university men students. Hence, the present study aimed to examine and compare the effects of tempo and intermittent running training on speed endurance.

I.1. TEMPO RUNNING TRAINING

Tempo running is a structured endurance training method characterized by continuous running at a controlled, sub-maximal intensity, typically ranging between 70–85% of maximal heart rate or close to the lactate threshold. The primary objective of tempo running is to enhance an athlete's ability to sustain relatively high speeds over prolonged durations by delaying the onset of fatigue. From a physiological perspective, tempo running predominantly stresses the aerobic energy system while also eliciting adaptations in the lactate production–clearance balance. Regular exposure to tempo intensity improves mitochondrial density, capillary proliferation, and oxidative enzyme activity, which collectively enhance oxygen delivery and utilization by working

muscles. These adaptations contribute to improved running economy and an elevated lactate threshold, allowing athletes to maintain higher speeds with reduced metabolic strain.

Tempo running is particularly effective during the preparatory and pre-competitive phases of training, as it establishes an aerobic foundation essential for speed endurance development. Unlike high-intensity interval training, tempo running imposes relatively lower neuromuscular stress, making it suitable for maintaining training consistency with minimal injury risk. Consequently, it is widely used in middle-distance running and team sports conditioning to improve the ability to tolerate sustained fast running. However, while tempo running significantly enhances aerobic endurance and fatigue resistance, its impact on maximal anaerobic capacity and repeated sprint performance is comparatively limited. Therefore, its effectiveness on speed endurance is more pronounced in activities requiring prolonged high-speed efforts rather than repeated maximal sprints.

I.II. INTERMITTENT RUNNING TRAINING

Intermittent running training involves alternating bouts of high-intensity running and recovery periods, either active or passive. The intensity of work intervals typically ranges from 85–100% of maximal speed or VO_2 max, making this method highly effective for developing both aerobic and anaerobic energy systems simultaneously. Physiologically, intermittent running places significant stress on the glycolytic and phosphagen systems, while also eliciting substantial cardiovascular adaptations. Repeated high-intensity efforts increase maximal oxygen uptake (VO_2 max), buffering capacity, and phosphocreatine resynthesis efficiency, all of which are crucial for maintaining speed under fatigue. Additionally, intermittent training enhances neuromuscular coordination, motor unit recruitment, and muscle fiber oxidative capacity, particularly in type II fibres.

One of the key advantages of intermittent running is its strong transferability to sports that demand repeated sprint ability and speed endurance, such as football, hockey, basketball, and athletics. The intermittent nature of the training closely mimics competitive movement patterns, thereby improving both physiological readiness and performance specificity. Research consistently demonstrates that intermittent running produces greater improvements in speed endurance compared to continuous training methods, especially when the performance outcome involves sustaining high-intensity efforts repeatedly. However, due to its high mechanical and metabolic load, careful programming and adequate recovery are essential to minimize overtraining and injury risk.

I.III. COMPARATIVE PERSPECTIVE ON SPEED ENDURANCE DEVELOPMENT

When comparing tempo and intermittent running, both methods contribute positively to speed endurance, but through different adaptive pathways. Tempo running primarily improves fatigue resistance and aerobic efficiency, enabling athletes to sustain fast paces for longer durations. In contrast, intermittent running enhances high-intensity performance sustainability, recovery between efforts, and anaerobic tolerance, making it more effective for improving speed endurance in competitive sport contexts.

For university men students, who often participate in sports requiring repeated high-speed actions, intermittent running may offer superior performance benefits. Nevertheless, an integrated training approach—utilizing tempo running in early phases and intermittent running in later phases—may provide optimal long-term adaptations. The purpose of the study was to compare the effects of tempo running and intermittent running training on selected speed endurance variables among university men students.

I.IV. HYPOTHESES

1. There would be a significant improvement in speed endurance due to tempo running training.
2. There would be a significant improvement in speed endurance due to intermittent running training.
3. There would be a significant difference between tempo running and intermittent running training on speed endurance.

II. METHODOLOGY

The present study employed a randomized pre-test–post-test control group experimental design to examine the comparative effects of tempo running and intermittent running training on speed endurance among university men students. This design enabled the assessment of training-induced changes while controlling for baseline differences.

II.I. PARTICIPANTS

A total of forty-five (N = 45) male university students, aged 18–25 years, were selected as participants for the study. All subjects were free from musculoskeletal injuries and cardiovascular disorders and had not participated in any systematic endurance or speed training programme during the six months preceding the study. Medical clearance was obtained prior to participation.

II.II. SAMPLING TECHNIQUE AND GROUPING

The subjects were randomly assigned into three equal groups (n = 15 each) using a lottery method:

- Group I: Tempo Running Group (TRG)
- Group II: Intermittent Running Group (IRG)
- Group III: Control Group (CG)

II.III. INDEPENDENT VARIABLES

1. Tempo Running Training

Continuous running performed at a controlled sub-maximal intensity (approximately 70–85% of maximum heart rate), aimed at enhancing aerobic efficiency and fatigue tolerance.

2. Intermittent Running Training

Repeated bouts of high-intensity running interspersed with fixed recovery intervals, designed to improve anaerobic capacity, neuromuscular coordination, and repeated sprint ability.

II.IV. DEPENDENT VARIABLE

1. Speed Endurance

Speed endurance was operationally defined as the ability to maintain near-maximal running speed over a short-to-middle distance under fatigue conditions and was measured using a 150-metre run test, with performance recorded in seconds.

II.V. TRAINING PROGRAMME

The training intervention was carried out for a duration of eight weeks, with three sessions per week on alternate days. Each training session lasted approximately 45–60 minutes, including standardized warm-up and cool-down.

II.VI. TEMPO RUNNING GROUP (TRG)

Participants performed continuous tempo runs at a steady pace corresponding to their individual tempo intensity. Training volume was gradually increased across the training period to ensure progressive overload.

II.VII. INTERMITTENT RUNNING GROUP (IRG)

Participants performed repeated high-intensity runs over short distances with active recovery intervals. The number of repetitions and intensity were progressively increased throughout the training period.

II.VIII. CONTROL GROUP (CG)

Participants in the control group continued their regular physical activities without participating in any structured training programme.

II.IX. TESTING PROCEDURE

The 150-metre run test was administered to all participants under standardized conditions on a standard athletics track. Each subject performed one maximal trial, and the time taken to complete the distance was recorded using a digital stopwatch. A pre-test was conducted prior to the commencement of the training programme, and a post-test was conducted immediately after the completion of the eight-week intervention. Adequate recovery was provided before testing to avoid fatigue effects.

II.X. STATISTICAL ANALYSIS

Descriptive statistics (mean and standard deviation) were computed for all variables. Analysis of Covariance (ANCOVA) was applied to examine differences among the three groups, with pre-test scores used as the covariate. When a significant F-ratio was obtained, post-hoc comparisons were conducted to identify specific group differences. Statistical significance was set at $p < 0.05$.

III. RESULTS

The ANCOVA results revealed a statistically significant difference among the three groups on speed endurance. Post-hoc analysis indicated that both tempo running and intermittent running groups showed significant improvement compared to the control group. Additionally, the intermittent running group demonstrated significantly greater improvement in speed endurance than the tempo running group.

COMPUTATION OF ANALYSIS OF COVARIANCE OF TEMPO RUNNING, INTERMITTENT RUNNING AND CONTROL GROUPS ON SPEED ENDURANCE

Table-1

Test	Intermittent	Tempo	Control	SV	SS	df	MS	F
Pre test	21.05	20.99	21.15	BG	0.42	2	0.21	2.31
				WG	2.31	42	0.09	
Post test	19.35	20.03	21.05	BG	23.68	2	11.84	98.67*
				WG	5.04	42	0.12	
Adj post Test	19.37	20.02	21.06	BG	22.91	2	11.46	104.18*
				WG	4.39	41	0.11	

*Significant at 0.05 with table value for 2 and 42 is 3.22

Table-1, shows that the pre test mean values on speed endurance of tempo running, intermittent running and control groups are 21.05, 20.99 and 21.15 respectively. The obtained “F” ratio of 2.31 pre test score was lesser than the required table value of 3.22 for df 2 and 42 for significance at 0.05 level of confidence on speed endurance. The post test mean values on speed endurance of tempo running, intermittent running and control groups are 19.65, 20.03 and 21.05 respectively. The obtained “F” ratio value of 98.67 for post test score was greater than the required table value of 3.22 for df 2 and 42 for significance at 0.05 level of confidence on speed endurance. The adjusted post test mean value on speed endurance of tempo running, intermittent running and control groups are 19.37, 20.02 and 21.06 respectively. The obtained “F” ratio value of 104.18 for adjusted post test score was greater than the required table value of 3.23 for df 2 and 41 for significance at 0.05 level of confidence on speed endurance.

The results of the study indicated that there was significant difference among the adjusted post test mean of tempo running, intermittent running and control groups on speed endurance. To determine the significance difference among the three paired means the Scheffe's test was applied as post hoc test and the results are presented in table- 2.

SCHEFFE'S TEST FOR THE DIFFERENCE BETWEEN THE ADJUSTED POST TEST MEAN ON SPEED ENDURANCE

Table-2

Intermittent	Tempo	Control	Mean difference
19.37		21.06	0.68*
19.37	20.02		1.04*
	20.02	21.06	1.72*

Scheffe's post hoc test revealed that the Intermittent running group differed significantly from both the Tempo running and the control group at the 0.05 level of significance. However, the difference between the Tempo running and the control group was also statistically significant. These results indicate that the Intermittent running training program was more effective in speed endurance improvement.

IV. DISCUSSION

The primary objective of the present study was to compare the effects of tempo running and intermittent running training on speed endurance among university men students. The findings clearly demonstrate that both training methods significantly improved speed endurance, with intermittent running training producing superior gains compared to tempo running training.

The significant improvement observed in the tempo running group may be attributed to enhanced aerobic efficiency and improved lactate clearance capacity. Continuous running at sub-maximal intensity is known to increase mitochondrial density and capillary supply, which enables athletes to sustain higher running speeds for longer durations with delayed fatigue. These adaptations are particularly beneficial for maintaining speed over middle distances such as the 150 metres.

The greater improvement shown by the intermittent running group can be explained by the high-intensity nature of the training protocol. Intermittent running exposes athletes to repeated bouts of near-maximal speed, interspersed with recovery periods, thereby stressing both anaerobic and aerobic energy systems. This form of training enhances phosphocreatine resynthesis, buffering capacity, neuromuscular coordination, and tolerance to metabolic fatigue. As a result, participants were able to maintain higher speeds throughout the 150-metre run, reflecting superior speed endurance development.

The minimal changes observed in the control group confirm that regular physical activity without structured training is insufficient to bring about meaningful improvements in speed endurance. These further highlights the importance of scientifically designed training interventions.

The present findings are in agreement with previous research, which has consistently reported that interval-based or intermittent training methods are more effective than continuous training for improving speed endurance and repeated sprint performance. The results also support contemporary training principles suggesting that tempo running is beneficial during preparatory phases, while intermittent running is more effective during performance-oriented phases.

V. CONCLUSION

The present study investigated the comparative effects of tempo running and intermittent running training on speed endurance among university men students, using the 150-metre run as the performance criterion. The findings clearly demonstrated that both training interventions produced significant improvements in speed endurance when compared to the control group. However, intermittent running training resulted in significantly greater enhancement than tempo running training.

The improvement observed in the tempo running group may be attributed to increased aerobic efficiency and improved fatigue tolerance, enabling participants to sustain higher running speeds over the selected distance. In contrast, the superior gains exhibited by the intermittent running group highlight the effectiveness of high-intensity, interval-based training in improving anaerobic capacity, neuromuscular coordination, and the ability to maintain speed under fatigue conditions.

The absence of meaningful improvement in the control group confirms that unstructured physical activity alone is insufficient to develop speed endurance, emphasizing the importance of scientifically planned training programmes. Overall, the results of the study suggest that intermittent running training is a more effective method than tempo running training for enhancing speed endurance performance over 150 metres among university men students.

These findings provide valuable insights for coaches, physical educators, and strength and conditioning professionals in designing evidence-based training programmes aimed at improving speed endurance in university-level athletes.

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