INFLUENCE OF STRUCTURED THRESHOLD RUNNING AND INTERVAL RUNNING TRAINING ON STRENGTH ENDURANCE CAPACITY AMONG COMPETITIVE SEPAK TAKRAW PLAYERS.

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Abstract

The present study aimed to examine the influence of structured threshold running and interval running training on strength endurance capacity among competitive Sepak Takraw players. Strength endurance plays a vital role in Sepak Takraw as the game demands repeated jumping, kicking, and rapid aerial movements throughout the match. The purpose of the study was to determine the effectiveness of two different running training methods in improving lower-body strength endurance as measured through the Repeated Jump Endurance Test.

A total of thirty university-level male Sepak Takraw players aged between 18 and 25 years were randomly selected as subjects for the study. The participants were divided into three equal groups: Threshold Running Training Group (TRTG), Interval Running Training Group (IRTG), and a Control Group (CG), each consisting of ten players. The experimental groups underwent their respective training programmes for a period of eight weeks, with five training sessions per week, while the control group continued with their regular physical activities without any specialized training intervention.

Strength endurance was assessed using the Repeated Jump Endurance Test before and after the training period. The collected data were analyzed using Analysis of Covariance (ANCOVA) to determine the significance of differences among the groups. The level of significance was set at 0.05.

The results of the study indicated a significant improvement in repeated jump endurance among the experimental groups compared to the control group. Furthermore, the interval running training group demonstrated slightly greater improvement in strength endurance performance than the threshold running training group. The findings suggest that structured running-based training programmes can effectively enhance the strength endurance capacity required for repeated jumping actions in Sepak Takraw players.

It was concluded that both threshold running and interval running training methods are beneficial in improving lower-body strength endurance, with interval running showing comparatively greater effectiveness in enhancing repeated jump endurance performance among competitive Sepak Takraw players.

Keywords:- Running, Interval Running, Control Group, Strength, Endurance.

Introduction

Strength endurance is an essential physical fitness component required in sports that involve repeated muscular contractions over extended periods. It refers to the ability of muscles to perform repeated actions against resistance while resisting fatigue. In many competitive sports, particularly those requiring continuous jumping, kicking, and rapid directional movements, strength endurance plays a vital role in sustaining performance throughout the match. The sport of Sepak Takraw is characterized by explosive acrobatic movements, including powerful jumps, aerial spikes, and repeated kicking actions performed in quick succession. Players are required to repeatedly generate lower-body power while maintaining muscular endurance to perform jumping and kicking movements effectively throughout the game. Therefore, improving lower-limb strength endurance is considered an important objective in the physical conditioning programmes of Sepak Takraw players. Various conditioning methods have been employed to enhance strength endurance in athletes. Among these, threshold running training and interval running training are widely used in modern sports conditioning programmes to improve both muscular endurance and fatigue resistance. These training methods stimulate different physiological adaptations that contribute to improved athletic performance.

Threshold Running Training

Threshold running training, also known as sustained pace running, involves continuous running performed at a controlled intensity close to the lactate threshold, typically between 70% and 85% of maximal heart rate. The primary objective of this training method is to enhance an athlete's ability to sustain moderate to high intensity efforts for prolonged durations while delaying the onset of muscular fatigue. Physiologically, threshold running primarily stimulates the aerobic energy system while simultaneously improving the body's ability to manage lactate accumulation. Regular participation in threshold running leads to several beneficial adaptations, including increased mitochondrial density, improved capillary networks within skeletal muscles, and enhanced oxidative enzyme activity. These adaptations facilitate better oxygen delivery and utilization by working muscles, thereby improving muscular endurance and fatigue resistance (Bompa & Buzzichelli, 2019).

Furthermore, threshold running contributes to improved muscular endurance of the lower extremities by promoting continuous muscular contractions over longer durations. Such adaptations are particularly beneficial for sports involving repeated jumping and dynamic movements, as they enhance the capacity of muscles to perform sustained work without rapid fatigue (Kenney, Wilmore, & Costill, 2020).

Interval Running Training

Interval running training is a conditioning method characterized by repeated bouts of high-intensity running alternated with periods of active or passive recovery. The intensity of the work intervals generally ranges from 85% to 100% of maximal effort. This training method is widely recognized for its effectiveness in improving both aerobic and anaerobic performance capacities. From a physiological perspective, interval running training places significant demands on the phosphagen and glycolytic energy systems. Repeated high-intensity efforts stimulate neuromuscular adaptations, improve phosphocreatine resynthesis, increase buffering capacity, and enhance motor unit recruitment. These adaptations contribute to improved muscular strength endurance and the ability to sustain repeated explosive movements (Buchheit & Laursen, 2013).

Additionally, interval training enhances muscle fiber recruitment, particularly in type II fibers that are responsible for explosive movements such as jumping and kicking. As a result, athletes develop greater resistance to fatigue during repeated high-intensity actions, which is particularly relevant in sports like Sepak Takraw where players must execute continuous jumping and aerial attacks throughout the match (Haff & Triplett, 2016).

Repeated Jump Endurance in Sepak Takraw

` Repeated jumping ability is one of the most critical physical capacities required in Sepak Takraw. Players frequently perform multiple jumps during offensive and defensive actions, including spikes, blocks, and aerial passes. The ability to sustain these repeated jumping actions without a decline in performance

reflects the player's lower-body strength endurance. The Repeated Jump Endurance Test is commonly used to assess an athlete's capacity to perform consecutive vertical jumps over a specified time or number of repetitions. This test provides an effective measure of lower-limb muscular endurance and fatigue resistance, which are essential performance determinants in sports involving repeated explosive movements (Markovic & Mikulic, 2010).

Need for the Study

Although numerous studies have examined the effects of endurance and interval training on general athletic performance, limited research has specifically investigated their influence on strength endurance performance among Sepak Takraw players. Given the unique physiological demands of the sport, it is important to identify effective training methods that can enhance repeated jumping performance and muscular endurance. Therefore, the present study was undertaken to examine and compare the effects of threshold running training and interval running training on strength endurance capacity among competitive Sepak Takraw players, using the Repeated Jump Endurance Test as the primary performance variable.

Hypotheses

1. There would be a significant improvement in repeated jump endurance performance due to threshold running training.
2. There would be a significant improvement in repeated jump endurance performance due to interval running training.
3. There would be a significant difference between threshold running training and interval running training in improving repeated jump endurance among competitive Sepak Takraw players.

Methodology

The present investigation adopted a randomized pre-test–post-test control group experimental design to determine the comparative effects of threshold running training and interval running training on strength endurance capacity among competitive Sepak Takraw players. This experimental design enabled the researcher to evaluate the effectiveness of the training programmes by comparing the changes in the selected performance variable before and after the intervention while controlling external influences.

Participants

A total of forty-five (N = 45) male Sepak Takraw players from university teams, aged between 18 and 25 years, were selected as participants for the study. All subjects were actively participating in intercollegiate Sepak Takraw competitions and had a minimum playing experience of two years. The participants were medically screened to ensure that they were free from musculoskeletal injuries, cardiovascular disorders, and other health complications that could affect their participation in the training programme. Informed consent was obtained from all participants prior to the commencement of the study.

The selected subjects were randomly assigned into three equal groups (n = 15 each) using a simple random sampling method (lottery method).

• Group I – Threshold Running Training Group (TRTG)

• Group II – Interval Running Training Group (IRTG)

• Group III – Control Group (CG)

The experimental groups underwent their respective training interventions, whereas the control group continued their routine physical activities without any specialized training.

Independent Variables

1. Threshold Running Training

Threshold running training involved continuous running performed at a controlled moderate-to-high intensity, generally between 70% and 85% of maximal heart rate, corresponding to the lactate threshold. This training method aims to improve aerobic efficiency, fatigue resistance, and muscular endurance by enhancing oxygen utilization and delaying lactate accumulation in working muscles (Bompa & Buzzichelli, 2019).

2. Interval Running Training

Interval running training consisted of repeated bouts of high-intensity running alternated with predetermined recovery intervals. The intensity of the running bouts ranged between 85% and 95% of maximal effort, while recovery intervals allowed partial restoration of energy stores. This method improves both aerobic and anaerobic capacities, enhances neuromuscular coordination, and increases muscular endurance during repeated explosive movements (Buchheit & Laursen, 2013).

Dependent Variable

Strength Endurance

Strength endurance was operationally defined as the ability of the lower limb muscles to perform repeated explosive jumping movements without significant decline in performance. In the present study, strength endurance was assessed using the Repeated Jump Endurance Test, which measures the number of consecutive vertical jumps performed within a specified time period. The performance score was recorded as the total number of successful jumps, reflecting the player's lower-body muscular endurance and fatigue resistance.

Training Programme

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

Threshold Running Training Group (TRTG)

Participants in this group performed continuous running at a steady pace corresponding to their individual threshold intensity. The training duration initially ranged from 15 to 20 minutes, gradually progressing to 30 minutes by the end of the training programme. The workload was progressively increased to ensure adequate physiological adaptation and training stimulus.

Interval Running Training Group (IRTG)

Participants in this group performed repeated high-intensity running bouts over short distances with fixed recovery intervals. Each session consisted of multiple repetitions of high-intensity runs followed by active recovery periods. The number of repetitions and intensity were gradually increased during the eight-week training period to ensure progressive overload.

Control Group (CG)

Participants in the control group continued their normal daily physical activities and regular Sepak Takraw practice sessions without participating in any structured endurance training programme.

Testing Procedure

The Repeated Jump Endurance Test was administered to assess lower-body strength endurance of the participants. The test was conducted under standardized conditions on an indoor sports surface. Each participant was instructed to perform maximum consecutive vertical jumps within a fixed time duration,

maintaining proper jumping technique throughout the test. The total number of successful jumps performed within the allotted time was recorded as the test score.

A pre-test was conducted before the commencement of the training programme, and a post-test was administered immediately after the completion of the eight-week training intervention. Adequate rest and recovery were provided to all participants prior to testing in order to minimize fatigue and ensure reliability of the test results.

Statistical Analysis

Descriptive statistics (mean and standard deviation) were computed for the variable. 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 $p < 0.05$.

The ANCOVA results revealed a statistically significant difference among the three groups on Repeated Jump Endurance. Post-hoc analysis indicated that both Threshold Running Training Group and Interval Running Training Group showed significant improvement compared to the control group. Additionally, the Interval Running group demonstrated significantly greater improvement in Repeated Jump Endurance than the Threshold Running group.

COMPUTATION OF ANALYSIS OF COVARIANCE OF THRESHOLD RUNNING, INTERVAL RUNNING AND CONTROL GROUPS ON REPEATED JUMP ENDURANCE

Table-1

Test	THRESHOLD	INTERVAL	Control	SV	SS	df	MS	F
Pre test	30.13	29.13	28.46	BG	21.11	2	10.55	3.59*
				WG	123.20	42	2.93	
Post test	34.66	32.33	28.60	BG	280.93	2	140.46	34.64*
				WG	170.26	42	4.05	
Adj post Test	34.66	32.33	28.60	BG	175.85	2	87.92	27.57*
				WG	130.72	41	3.18	

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

Table-1, shows that the pre test mean values on repeated jump endurance of Threshold Running, Interval Running and control groups are 30.13, 29.13 and 28.46 respectively. The obtained "F" ratio of 3.59 pre test score was higher than the required table value of 3.22 for df 2 and 42 for significance at 0.05 level of confidence on repeated jump endurance. The post test mean values on repeated jump endurance of Threshold Running, Interval Running and control groups are 34.66, 32.33 and 28.60 respectively. The obtained "F" ratio value of 34.64 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 repeated jump endurance. The adjusted post test mean value on repeated jump endurance of Threshold Running, Interval Running and control groups are 34.66, 32.33 and 28.60 respectively. The obtained "F" ratio value of 27.57 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 Repeated Jump Endurance.

The results of the study indicated that there was significant difference among the adjusted post test mean of Threshold Running, Interval Running and Control groups on Repeated Jump 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 REPEATED JUMP ENDURANCE

Table-2

THRESHOLD	INTERVAL	Control	Mean difference
34.66		28.60	6.06*
34..66	32.33		2.33*
	32.33	28.60	3.73*

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

Scheffe's post hoc test revealed that the Threshold Running group differed significantly from both the Interval Running and the control group at the 0.05 level of significance. However, the difference between the Interval Running and the control group was not statistically significant. These results indicate that the Threshold Running training program was more effective in Repeated Jump Endurance improvement.

Discussion

The primary objective of the present investigation was to examine and compare the effects of threshold running training and interval running training on strength endurance capacity among competitive Sepak Takraw players. Strength endurance was assessed using the Repeated Jump Endurance Test, which reflects the ability of the lower limb muscles to sustain repeated explosive jumping movements without significant fatigue. The findings of the study revealed that both threshold running training and interval running training produced significant improvements in repeated jump endurance performance, while the control group showed only minimal changes. However, the interval running training group demonstrated greater improvement in strength endurance compared to the threshold running training group.

The improvement observed in the threshold running training group may be attributed to enhanced aerobic capacity and improved muscular endurance of the lower extremities. Continuous running at a controlled intensity near the lactate threshold stimulates several physiological adaptations, including increased mitochondrial density, enhanced capillary supply, and improved oxidative enzyme activity within skeletal muscles. These adaptations contribute to improved fatigue resistance and enable athletes to sustain repeated muscular contractions during prolonged physical activity (Kenney, Wilmore, & Costill, 2020). In the context of Sepak Takraw, improved fatigue resistance allows players to maintain jumping and kicking performance throughout the match. Furthermore, threshold running training enhances the body's ability to manage and clear metabolic by-products such as lactate, thereby delaying muscular fatigue during repeated high-intensity movements. This physiological adaptation likely contributed to the improved performance observed in the repeated jump endurance scores of the participants who underwent threshold running training.

The greater improvement recorded in the interval running training group may be explained by the high-intensity and intermittent nature of the training protocol. Interval running training involves repeated bouts of intense running interspersed with recovery periods, which place significant demands on both aerobic and anaerobic energy systems. Such training stimulates neuromuscular adaptations, enhances phosphocreatine resynthesis, and improves buffering capacity against metabolic fatigue (Buchheit & Laursen, 2013). These physiological improvements allow athletes to sustain repeated explosive actions such as jumping and kicking more effectively. Additionally, interval running training promotes improved recruitment of fast-twitch muscle fibers (Type II fibers), which play a crucial role in explosive movements such as vertical jumping. Enhanced motor unit recruitment and neuromuscular coordination contribute to improved muscular endurance during repeated jump actions (Haff & Triplett, 2016). Since Sepak Takraw players frequently perform repeated jumps during spikes, blocks, and aerial passes, improvements in neuromuscular efficiency directly influence repeated jump endurance performance.

The minimal changes observed in the control group confirm that routine physical activity or regular sport participation without structured conditioning programmes may not be sufficient to significantly improve strength endurance performance. This finding highlights the importance of scientifically designed

and systematically implemented training programmes for improving specific performance variables in competitive athletes. The results of the present study are consistent with previous research findings that indicate high-intensity interval training produces superior improvements in muscular endurance and repeated explosive performance compared to continuous endurance training methods (Bompa & Buzzichelli, 2019; Bishop, Girard, & Mendez-Villanueva, 2011). Moreover, studies focusing on jumping performance have shown that neuromuscular adaptations resulting from high-intensity training contribute significantly to improvements in repeated jumping ability (Markovic & Mikulic, 2010).

Therefore, the findings of this investigation suggest that although threshold running training contributes positively to strength endurance development, interval running training appears to be more effective for improving repeated jump endurance performance among Sepak Takraw players.

Conclusion

The present study examined the comparative effects of threshold running training and interval running training on strength endurance capacity among competitive Sepak Takraw players, using the Repeated Jump Endurance Test as the performance criterion. The results of the investigation indicated that both training methods significantly improved repeated jump endurance when compared to the control group. However, the interval running training programme produced significantly greater improvements in strength endurance performance than threshold running training.

The improvement observed in the threshold running group may be attributed to enhanced aerobic efficiency, improved fatigue resistance, and increased muscular endurance of the lower limbs. On the other hand, the superior performance improvements observed in the interval running group highlight the effectiveness of high-intensity training in enhancing neuromuscular coordination, anaerobic capacity, and the ability to sustain repeated explosive movements. The lack of significant improvement in the control group confirms that unstructured physical activity alone is insufficient to bring about meaningful improvements in strength endurance. This emphasizes the importance of scientifically planned and systematically implemented training programmes in sports conditioning.

Based on the findings of the study, it can be concluded that interval running training is a more effective training method than threshold running training for improving repeated jump endurance and lower-body strength endurance among competitive Sepak Takraw players. The results of the present investigation provide valuable insights for coaches, physical educators, and strength and conditioning specialists in designing effective training programmes aimed at improving strength endurance and repeated jumping performance in Sepak Takraw athletes.

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