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"Effectiveness of Circuit Training on Muscular Endurance and Speed A mong Football Players"

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Abstract:

Background: Football is a team sport that requires both endurance and speed. Players perform short sprints, rapid acceleration and deceleration, quick directional changes, jumping, and tackling. During a match, players typically cover 9–12 km, with only a small portion spent at maximum intensity. Football is one of the most watched and complex sports worldwide. With advances in science and technology, the sport has modernized, and women footballers are now given opportunities similar to men.

Objective: The objective of the study is to evaluate the effectiveness of circuit training on muscular endurance and speed among football players.

Methods: An experimental study was conducted in the Revathi group of colleges for a total duration of 6 months. A sample size of 30 participants was included: those who are within the age group of 18 to 23 years, who are actively participating in football for 2 years, and who are willing to participate in the exercise program. The 30 participants will receive circuit training for 60 minutes. Training will be for 8 weeks, 4 days a Week.

Results: The experimental group showed a highly significant improvement in speed and muscular endurance, with the 40-meter shuttle run score and cooper's 12 minutes run score increasing, leading to rejection of the null hypothesis.

Conclusion: The study concluded that circuit training was effective in improving muscular endurance and speed among male football players. The players showed better running, speed, and muscular endurance after the circuit training programme; therefore, circuit exercise should be included in regular football training.

Keywords: Football, Circuit training, Cooper 12-minute run test, 40-meter shuttle run test.

Introduction

Football is a team sport that requires a high level of physical fitness, endurance, and speed. The game involves repeated sprinting, rapid acceleration and deceleration, jumping, tackling, and quick changes in direction [1–4]. During a match, players cover an average distance of 9–12 kilometers, making physical conditioning an essential factor for successful performance [3, 4, 7]. Football players require well-developed muscular endurance and speed to maintain performance throughout the game [2, 3, 27].

Circuit Training is a structured method of exercise in which a series of exercises are performed in a specific sequence with minimal rest between stations [4, 6]. It combines cardiovascular and strength-training activities and is designed to improve overall physical fitness, muscular strength, endurance, and athletic performance [4–8, 23, 30, 32]. Circuit training is widely used in sports because it allows athletes to develop multiple fitness components within a single training session [4, 6, 7, 26].

Speed is the ability to move the body rapidly over a specific distance in the shortest possible time. It is an important component of football performance, as players frequently perform short sprints, rapid accelerations, and quick movements during match play [2, 10, 28, 31]. Improved speed contributes to better athletic performance and competitive success [2, 11–14, 28].

Muscular Endurance refers to the ability of a muscle or group of muscles to perform repeated contractions against resistance for an extended period without excessive fatigue [1, 23, 27]. It is essential for football players because the sport requires sustained physical effort throughout training sessions and competitive matches [1, 24, 25, 27]. Enhanced muscular endurance helps players maintain performance and delay the onset of fatigue [23, 27, 30, 32].

The 40-Meter Shuttle Run Test is used to assess speed and acceleration [16, 17]. It is commonly included in athletic performance testing programs and is considered a reliable method for evaluating sprint performance in sports that require rapid movement and directional changes [16, 17].

The Cooper's 12-Minute Run Test is a field test used to assess endurance performance by measuring the distance covered within twelve minutes [18–22, 29]. It is a practical and reliable test for evaluating physical fitness and endurance capacity in athletes [18, 20–22, 29].

Methods:

Study Design and Participants:

The study was approved by the institute ethics committee, IEC- RIPT/DT/21/4532. This pre- and post-experimental study was conducted to evaluate the effectiveness of circuit training on muscular endurance and speed among football players. The study was carried out over 6 months at S.A.K. Sports Arena, Tiruppur. 30 male football players aged 18–23 years were selected using purposive sampling. Participants had been actively involved in football for at least two years and were undergoing regular training. Players with injuries, chronic diseases, congenital deformities, or respiratory disorders were excluded. All participants underwent an 8-week circuit training program, performed four days per week with 60-minute sessions.

Inclusion and exclusion criteria:

The study included male football players aged 18–23 years who had been actively participating in football for at least two years and were willing to participate in the study. Players with lower limb injuries, chronic diseases, congenital deformities, respiratory disorders, involvement in other training programs, or those unwilling to participate were excluded from the study.

Intervention:

All participants underwent a circuit training program for 8 weeks. Training sessions were conducted 4 days per week, with each session lasting 60 minutes. The program consisted of a series of exercises including push-ups, planks, pull-ups, crunches, squats, lunges, box jumps, jumping jacks, and burpees performed in a circuit format. Participants completed a total of 32 training sessions under supervision.

Outcome Measures:

The outcome measures used in this study were the 40-Meter Shuttle Run Test and Cooper's 12-Minute Run Test. The 40-Meter Shuttle Run Test was used to assess speed, while the Cooper's 12-Minute Run Test was used to evaluate muscular endurance. Both tests were performed before and after the 8-week circuit training program to determine changes in performance.

Statistical Analysis:

The collected data were analyzed using the Statistical Package for Social Sciences (SPSS) version 24. Data normality was assessed using the Shapiro–Wilk test. Since the data were normally distributed ($p > 0.05$), parametric tests were applied. A paired t-test was used to compare the pre-test and post-test values, with the level of significance set at $p < 0.05$ and a 95% confidence interval.

Results:

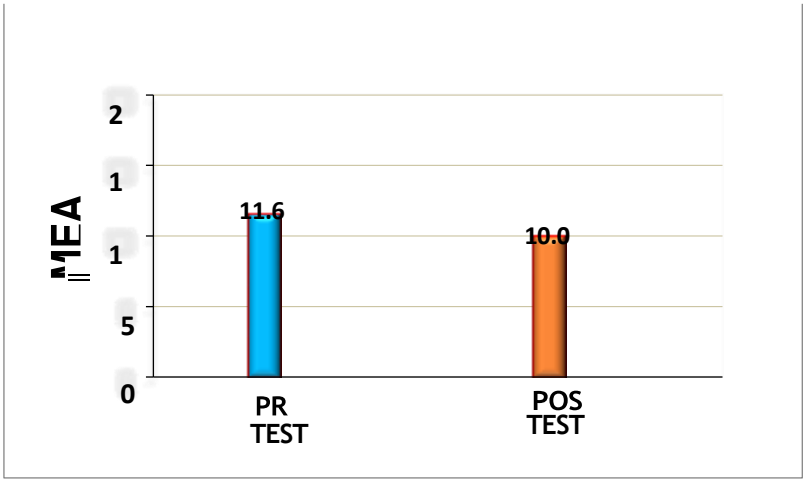
Thirty football players completed the 8-week circuit training program. The mean 40-meter Shuttle Run Test score improved from 10.18 ± 0.73 seconds to 8.95 ± 0.80 seconds following the intervention. Similarly, the mean Cooper's 12-Minute Run Test distance increased from 2054.50 ± 189.74 meters to 2217.33 ± 184.84 meters. Statistical analysis revealed a significant improvement in both speed and muscular endurance after circuit training ($p < 0.001$). These findings indicate that circuit training was effective in enhancing the physical performance of football players.

Table 1: Comparison of 40 Meter Shuttle Run Test Score Within Group (Pre-Test and Post-Test Values)

TEST	PRE-TEST		POST TEST		t - test	df	Sig
	MEAN	S.D	MEAN	S.D			
40MSRT	11.61	.492	10.03	.508	49.22	29	.001***

(*** $p \leq 0.001$ – Significant).

The above table reveals the Mean, Standard Deviation (S.D.), t-test, degrees of freedom (df), and p-value between pre-test and post-test. There is a statistically significant difference between the pre-test and post-test values within the group at $P \leq 0.001$.



Graph -1: Comparison of 40 Meter Shuttle Run Test Score within Group (Pre-Test and Post-Test Values)

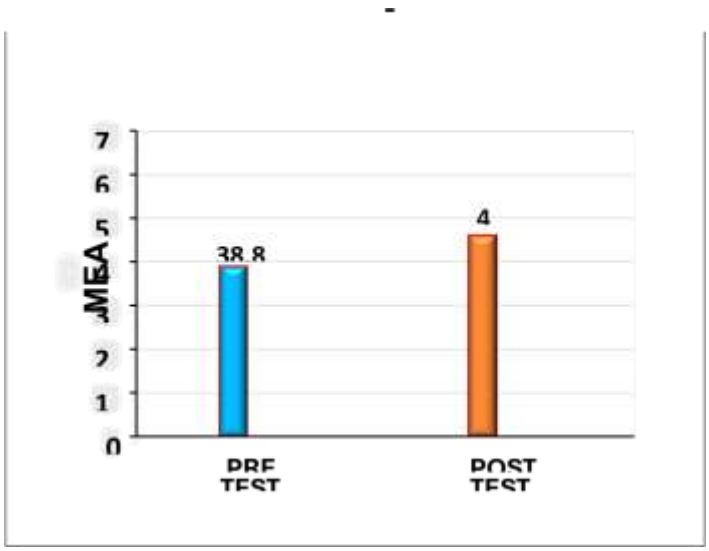
Table 2: Comparison of Cooper 12-Minute Run Test Score within Group (Pre-Test and Post-Test Values)

TEST	PRE-TEST		POST-TEST		t- test	df	Sig
	MEAN	S. D	MEAN	S. D			
12MRT	38.85	7.37	46.00	5.65	-10.41	29	.001***

(*** $p \leq 0.001$ - Significant).

The above table reveals the Mean, Standard Deviation (S.D.), t - test, degrees of freedom (df), and p-value between the pre-test and post-test.

There is a statistically significant difference between the pre-test and post-test values within the group at $P \leq 0.001$.



Graph -2: Comparison of Cooper 12 Minute Run Test Score within Group (Pre-Test and Post-Test Values)

Discussion:

The present study was conducted to evaluate the effectiveness of circuit training on muscular endurance and speed among football players. The findings revealed significant improvements in both outcome measures following the 8-week training program. Speed was assessed using the 40-Meter Shuttle Run Test, and the results showed an improvement from 10.18 ± 0.73 seconds in the pre-test to 8.95 ± 0.80 seconds in the post-test. This indicates that circuit training enhanced the players' ability to perform rapid movements and accelerations efficiently.

Muscular endurance was assessed using Cooper's 12-Minute Run Test. The mean distance covered increased from 2054.50 ± 189.74 meters before training to 2217.33± 184.84 meters after training, demonstrating improved endurance capacity. The repeated performance of multiple exercises with minimal rest intervals may have contributed to these improvements by enhancing cardiovascular fitness and muscular efficiency.

The statistical analysis showed a highly significant difference between the pre-test and post-test values ($p < 0.001$), indicating that the observed changes were a result of the circuit training intervention. The combination of aerobic and strengthening exercises incorporated in the training program may have improved both speed and endurance simultaneously. Therefore, the findings of this study suggest that circuit training is an effective and practical training method for improving the physical performance of football players and can be incorporated into regular football conditioning programs.

Conclusion:

The present study concluded that circuit training is an effective training method for improving muscular endurance and speed among football players. Following the 8week intervention, significant improvements were observed in both the 40-Meter Shuttle Run Test and Cooper's 12-Minute Run Test. The results demonstrated enhanced sprint performance and endurance capacity among the participants. Statistical analysis confirmed a significant difference between pre-test and post-test values ($p < 0.001$). Circuit training combines strength, endurance, and aerobic exercises, making it a comprehensive conditioning program. Therefore, circuit training can be incorporated into regular football training to enhance overall physical performance and fitness.

Limitations:

The study had certain limitations. The sample size was limited to 30 football players, which may restrict the generalization of the findings. The study was conducted at a single sports arena and included only male football players aged 18–23 years. The intervention period was limited to 8 weeks, and long-term effects were not assessed. Additionally, only speed and muscular endurance were evaluated, while other performance variables were not considered.

Recommendations:

Future studies should include a larger sample size and participants from different training centres to improve generalizability. Similar studies can be conducted among female football players and athletes from other sports. A longer intervention period may be used to evaluate the long-term effects of circuit training. Future research may also assess additional performance variables such as agility, power, strength, and cardiovascular fitness. Comparative studies with other training methods are recommended to determine the most effective conditioning program for football players.

Informed consent:

Written informed consent was obtained from all participants before enrolment in the study. Participants were informed about the study objectives, procedures, potential benefits, and their right to withdraw from the study at any time without any consequences.

Conflict of interest:

The authors declare that they have no conflict of interest regarding the publication of this study.

Author contributions:

Siva. S: Conceptualization, methodology, participant recruitment, data collection, manuscript preparation.

Dr. B.J.A.C Darrius: Study conception and design, supervision, methodology validation, interpretation of results, critical revision of the manuscript, and final approval of the manuscript.

Dr. P. Bright Alwin Victor: Administrative support, overall academic guidance, and final approval of the manuscript.

Data availability statement:

The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request

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