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Comparative Effects of Plyometric Training and Circuit Training on Physiological and Physical Fitness Variables in U-17 Male Football Trainees

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Abstract

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Keywords: *plyometric training, circuit training, speed, power, agility, resting heart rate, respiratory rate, football trainees*

This quasi-experimental study aimed to investigate and compare the effects of an 8-week plyometric training program and a circuit training program on selected physiological and physical fitness variables in U-17 male football trainees from the Ethiopian Sport Academy. The study involved 22 participants, who were randomly assigned to either the plyometric training group or the circuit training group. Measurements of speed, power, agility, resting heart rate, and respiratory rate were taken before and after the training programs. Statistical analysis was conducted using SPSS ver.20 and paired t-tests, with a significance level of 0.05. The results showed that the plyometric training group significantly improved in power ($p=0.00$, $p<0.05$), speed ($p=0.00$, $p<0.05$), and agility ($p=0.00$, $p<0.05$). The circuit training group significantly improved in speed ($p=0.00$, $p<0.05$), resting heart rate ($p=0.00$, $p<0.05$), and respiratory rate ($p=0.00$, $p<0.05$). Resting heart rate and respiratory rate did not show significant differences in the plyometric training group ($p>0.05$). Similarly, power and agility did not significantly improve in the circuit training group ($p>0.05$). Based on these findings, it can be concluded that an 8-week circuit training program has positive effects on speed, resting heart rate, and respiratory rate, while plyometric training has positive effects on speed, power, and agility. Accordingly, it is recommended that a combined session of circuit and plyometric training may lead to significant improvements in physiological and physical fitness variables in male football trainees.

Introduction

The field of sports science continuously seeks to identify effective training methods to optimize performance and enhance physiological and physical factors in athletes. Plyometric training and circuit training are two popular training modalities that have been shown to improve various fitness components. In the context of football, where

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speed, power, and agility are crucial, understanding the comparative effects of these training methods becomes particularly important. Therefore, this study aimed to investigate and compare the effects of an 8-week plyometric training program and a circuit training program on selected physiological and physical fitness variables in U-17 male football trainees from the Ethiopian Sport Academy.

Objective of the study

Objective of the study was to compare the effectiveness of circuit training and plyometric training on some selected physical fitness and physiological variables in male U-17 football trainees.

Methods

Participants:

A total of 22 U-17 male football trainees were recruited from the Ethiopian Sport Academy. Participants were randomly assigned to either the plyometric training group or the circuit training group.

Intervention

The plyometric training group underwent an 8-week plyometric training program, while the circuit training group underwent an 8-week circuit training program. The training interventions were conducted under the supervision of the coaches and consisted of specific exercises tailored to improve speed, power, agility, resting heart rate and respiratory rate.

Measurements

Before and after the training programs, participants' speed was assessed using a 30-meter acceleration test, power was evaluated through vertical jump performance, and agility was measured through the Illinois agility test. Resting heart rate was determined by counting the heartbeats for one minute, and respiratory rate was monitored by counting the breaths per minute at rest.

Statistical Analysis:

Statistical analysis was performed using SPSS ver.20. Paired t-tests were conducted to determine the significance of the training interventions on the measured variables, with a significance level set at 0.05.

Results

The results showed that the plyometric training group significantly improved in power ($p=0.00$, $p<0.05$), speed ($p=0.00$, $p<0.05$), and agility ($p=0.00$, $p<0.05$). In contrast, there were no significant differences in resting heart rate and respiratory rate following the plyometric training program ($p>0.05$). The circuit training group showed significant improvements in speed ($p=0.00$, $p<0.05$), resting heart rate ($p=0.00$, $p<0.05$), and respiratory rate ($p=0.00$, $p<0.05$). However, power and agility did not significantly improve in the circuit training group ($p>0.05$).

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Paired Sample t Test for Circuit and Plyometric Training

Variables	*Group Name*	*Mean*		*Std. Deviation*		*95% Confidence Interval of the difference*		*t*	*p value*
		Pre	***Post***	***Pre***	***Post***	***Lower***	***Upper***		
VJ (cm)	Circuit	54.00	56.27	4.54	4.86	-5.03	0.48	-1.84	0.09*
	Plyometric	55.54	65.91	5.01	3.65	-12.69	-8.03	-9.90	0.00
Agility	Circuit	16.82	16.55	0.40	0.52	-0.04	0.59	1.94	0.08*
(sec)	Plyometric	16.73	15.18	0.47	0.75	1.08	2.00	7.46	0.00
Speed	Circuit	4.63	3.99	0.19	0.33	0.46	0.81	8.24	0.00
(sec)	Plyometric	4.63	3.57	0.19	0.31	0.75	1.36	7.76	0.00
RHR	Circuit	66.27	62.09	5.78	4.70	1.96	6.41	4.19	0.00
(min)	Plyometric	66.64	66.00	7.07	5.02	-1.62	2.89	0.63	0.05*
RR /min	Circuit	16.27	14.00	1.42	1.09	1.59	2.95	7.47	0.00
	Plyometric	16.36	15.91	1.57	1.58	-0.24	1.15	1.46	0.18*

Table of paired t-test results of two groups of pre and post-test

Key: VJ=vertical jump, RHR=resting heart rate, RR=respiratory rate

DISCUSSION

The objective of this experimental research was to compare the effects of circuit training and plyometric exercise on speed, agility, respiratory rate, and heart rate at rest. U-17 male football trainees at the Ethiopian Sport Academy the findings of this study revealed that both training programs had differing effects on the various parameters measured.

The hypothesis was that there is a significant improvement between the circuit training group and the plyometric training group. The findings of this research showed that the plyometric training group saw significant improvements in speed, agility, and power between the pre- and post-tests. The paired t-test score for speed ($p = 0.000$, $p<0.05$), power ($p = 0.000$, $p<0.05$), and agility ($p = 0.000$, $p<0.05$) have witnessed the significant result whereas, there was no significant change in heart rate at rest ($p = 0.054$, $P > 0.05$) or respiratory rate ($p = 0.176$, $P > 0.05$) as seen by the paired t-test. This finding aligns with previous studies that have shown the beneficial effects of plyometric training on athletic performance. Bobbert et al. (1996)

previous research was conducted by Wang and Zhang (2016), who investigated the effects of plyometric training on sprint performance. The researchers concluded that plyometric exercises positively influenced speed development when implemented in a well-structured training program. These earlier conclusions are supported and confirmed by the present study's findings. Therefore, how effective plyometric exercise can be used to explain the increased speed seen in my sample of football players

Additionally, agility showed significant enhancements after the plyometric training program. This result is in line with the study conducted by Tendulkar et al. (2018), which examined football players' reactions to plyometric training. According to their research, incorporating plyometric exercises into training regimens has positive effects on agility abilities. My findings therefore support these earlier findings, supporting the idea that plyometric training could be a successful strategy for improving agility in football players.

Furthermore, power was significantly increased following the implementation of plyometric training. The findings of this research correspond with those of Fischetti et al. (2019). Plyometric training develops body power and agility abilities. Their research concluded that plyometric exercises had a direct influence on power output, leading to improvements in explosive leg strength. Thus, my results demonstrate a similar positive effect of plyometric training on power development, endorsing the notion that plyometrics can effectively enhance football players leg power. By aligning with previous research findings of Kumaravelu (P) that plyometric training improves power and agility However, there was no significant change in resting heart rate after eight weeks of plyometric training for adolescent boys. This result supports my findings from the study.

Overall, the results of this study reinforce and confirm other studies on the beneficial effects of plyometric training on athletes' speed, agility, and power. According to the findings, adding well-designed plyometric activities to training programs may significantly enhance these physical performance parameters. The drawbacks of this research, such as the limited sample size and short-term analysis, create opportunities for further investigation in this area.

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Overall, the present study contributes to the existing body of literature. By reinforcing the advantages of plyometric exercise for In the circuit training group the findings of this research study revealed positive results in terms of speed, resting heart rate, and respiratory rate. There was significant improvement between the pre- and post-test results, as seen by the paired t-test results for speed ($p = 0.00$, $p<0.05$), resting heart rate ($p = 0.002$, $p<0.05$), and respiratory rate ($p = 0.000$, $p<0.05$). Whereas, there was no significant change in power ($p = 0.096$, $P > 0.05$) or agility ($p = 0.08$, $P > 0.05$), as seen by the paired t-test results. The findings of my study clearly demonstrated that circuit training has a positive effect on these variables. Specifically, participants who engaged in regular circuit training experienced improvements in their speed as well as reductions in RHR and RR.

A study by Muniraju and Santhosha (2019) discovered comparable outcomes, with speed gains and decreases in resting heart rate and respiratory rate following a 6-week circuit training program. These results confirm the benefit of circuit training on these factors and support the relevance of my study. This study enhancing speed, agility, and power in football trainees.

showed that different performance indicators in U-17 male football trainees respond differently to plyometric training and circuit training. While circuit training considerably increased speed, resting heart rate, and respiratory rate, plyometric exercise was found to greatly increase speed, power, and agility. However, it is crucial to note that neither training program had a significant impact on every parameter measured. Future studies could further explore the potential synergistic benefits of combining these two training methods to optimize athletic performance in U-17 male football trainees.

Conclusion

Based on The results of the study, the following points were stated as conclusion

- Eight week of plyometric training was significance effect on speed, power and agility.
- Eight week of circuit training was significance effect on speed, heart rate and respiration rate at rest.

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