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PERFORMANCE-RELATED FITNESS OUTCOMES OF CIRCUIT-BASED TRAINING IN EARLY ADULT FEMALE VOLLEYBALL PLAYERS: CRT VERSUS ACRT

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Abstract
The objective of the research was to assess the "Comparative Effects of Circuit Resistance Training and Aerobic Circuit Resistance Training on Speed and Speed Endurance of Early Adult Female Volleyball Players (20-25 Years)." We randomly picked 63 female volleyball players and then split them into three groups of equal size. Participants in Group 1 underwent circuit resistance training (CRT), those in Group 2 engaged in aerobic circuit resistance training (ACRT), and individuals in Group 3 were allowed to take part in their standard volleyball practice without any supplementary training regimen.
This study concentrated on velocity and endurance of velocity as the primary dependent variables. The 30-meter sprint test was used to test speed both before and after the eight-week training session. The repeated shuttle run test was used to examine speed endurance. Both tests were conducted to assess the degree of speed endurance. We used an analysis of covariance, also known as an ANCOVA, to find out if there were any big differences between the three groups. The research demonstrated that both CRT and ACRT significantly enhanced speed and speed endurance compared to the control group. People in the CRT group showed better explosive speed, while people in the ACRT group showed better speed endurance.
The results show that both CRT and ACRT help early adult female volleyball players do better on speed-related performance tests. This gives trainers a framework for creating training plans that are based on research.
Some of the words that go with this article are "circuit resistance training," "aerobic circuit resistance training," "speed," "speed endurance," "female volleyball players," and "ANCOVA."

Key Words: *Circuit Resistance Training, Aerobic Circuit Resistance Training, Speed and Speed Endurance.*

Introduction

Players need to be quick, agile, powerful, and have a lot of endurance to do well in volleyball matches because the game moves quickly. Bompa and Haff (2009) say that speed and speed endurance let players move quickly, run for short distances, and repeat activities while they are playing the game. This is why speed and speed endurance are so important. To acquire an edge over the competition, young women who play volleyball need to work on these things.
Circuit resistance training (CRT) is a type of exercise that can help people get in shape. It involves doing a sequence of resistance exercises with very little rest in between each one. Doing the activities works out a lot of different muscle groups. Siva Sankar and Vara Prasad (2019) say that CRT can help you get stronger and faster, which are both important for reaching your best potential in volleyball. Vala and Chaudhari (2025) assert that Aerobic Circuit Resistance Training (ACRT) is a modality of resistance training that integrates aerobic exercises with resistance workouts to enhance cardiovascular endurance and the capacity for repeated sprints, ultimately resulting in an augmentation of speed endurance.
While other studies have examined CRT and ACRT separately, there is a lack of study that contrasts the two methodologies in early adult female volleyball players, utilizing speed and speed endurance as criterion variables. This represents a substantial deficiency in the study on these two techniques. This study aims to address the existing gap by evaluating the effects of CRT and ACRT compared to a control group on performance-related fitness components.

The results of this study will furnish coaches with insights that enable them to build training programs that are evidence-based and targeted.

Methodology

Participants:

The study included 63 female volleyball players in their early twenties. These athletes were between the ages of 20 and 25 and played volleyball competitively. The participants were split into three groups at random:

• **Group 1** (CRT, n = 21) will do Circuit Resistance Training.
• **Group 2** (ACRT, n = 21): Aerobic Circuit Resistance Training
• **Group 3** (Control, n = 21): Engaged solely in regular volleyball practice without any supplementary specialized training.

Design of the Study: To examine the impacts of CRT and ACRT on velocity and endurance, a randomized experimental design was utilized for the study. Pre-tests and post-tests were conducted to ascertain the variations in the specified dependent variables.

The Training Protocol:

The participants did circuit activities that worked on strength, like push-ups, sit-ups, medicine ball drills, and workouts using resistance bands. People call this kind of workout continuous resistance training (CRT).

The participants did aerobic circuit resistance training (ACRT), which was made up of circuits that included aerobic exercises like running, shuttle runs, and skipping, as well as resistance exercises that worked on main muscle groups.

Both experimental groups participated in physical activity three times a week for eight weeks, in terms of duration and frequency. The sessions lasted from 60 to 75 minutes and included a warm-up and a cool-down. There were no extra instructions for the control group.

Evaluation of Dependent Variables:

To test the subject's speed, they have to run 30 meters.

A series of shuttle run tests are employed to assess the athlete's speed endurance. The assessment of the dependent variables was conducted under controlled conditions prior to and during the intervention. The researchers conducted all of the tests.

We used an analysis of covariance (ANCOVA) to find significant differences between the three groups in our statistical analysis. In this analysis, we used the pre-test scores as covariates. The criteria for significance was established at $p < 0.05$.

All of the subjects gave their informed consent, which is an ethical issue. The study followed the ethical rules for research on people, making sure that everyone knew what the study was for, how it would be done, and what dangers there might be.

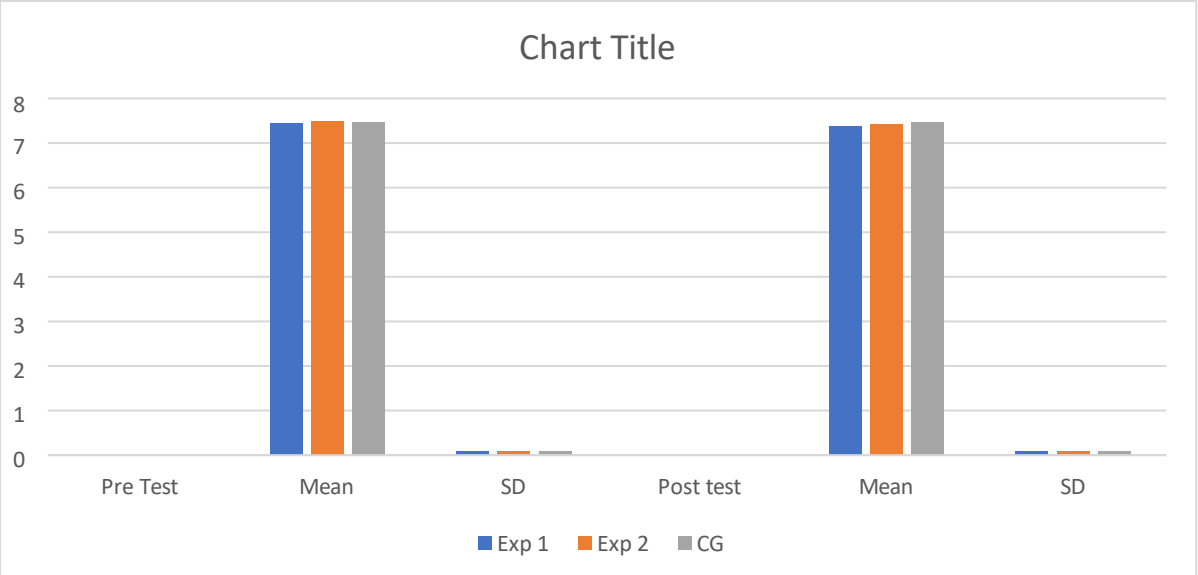
TABLE 1
Calculation of Analysis of Covariance (ANCOVA) for Pre-Test, Post-Test, and Adjusted Post-Test regarding the Speed of Experimental Group I, Experimental Group II, and Control Group (Scores in Seconds).

Test	*Exp. Group I*	*Exp. Group II*	*Control Group*	*Source of Variance*	*Sum of Squares*	*df*	*Mean Squares*	*F Value*
Pre-Test	Mean: 7.45	Mean: 7.48	Mean: 7.46	Between	0.0133	2	0.00665	1.23
	S.D.: 0.09	S.D.: 0.08	S.D.: 0.08	Within	0.3230	60	0.005383	
Post-Test	Mean: 7.34	Mean: 7.41	Mean: 7.46	Between	0.32221	2	0.161105	1361.9*

	S.D.: 0.09	S.D.: 0.08	S.D.: 0.08	Within	0.0071	60	0.0001183	
Adjusted Post-Test	Mean: 7.34	Mean: 7.36	Mean: 7.44	Between	0.2656	2	0.1328	322.3*
				Within	0.0243	59	0.000412	

*Significant at 0.05 level of confidence

Figure 1
Graphical Representation of mean value and Standard deviation for Experimental group 1, Experimental group 2 and Control group



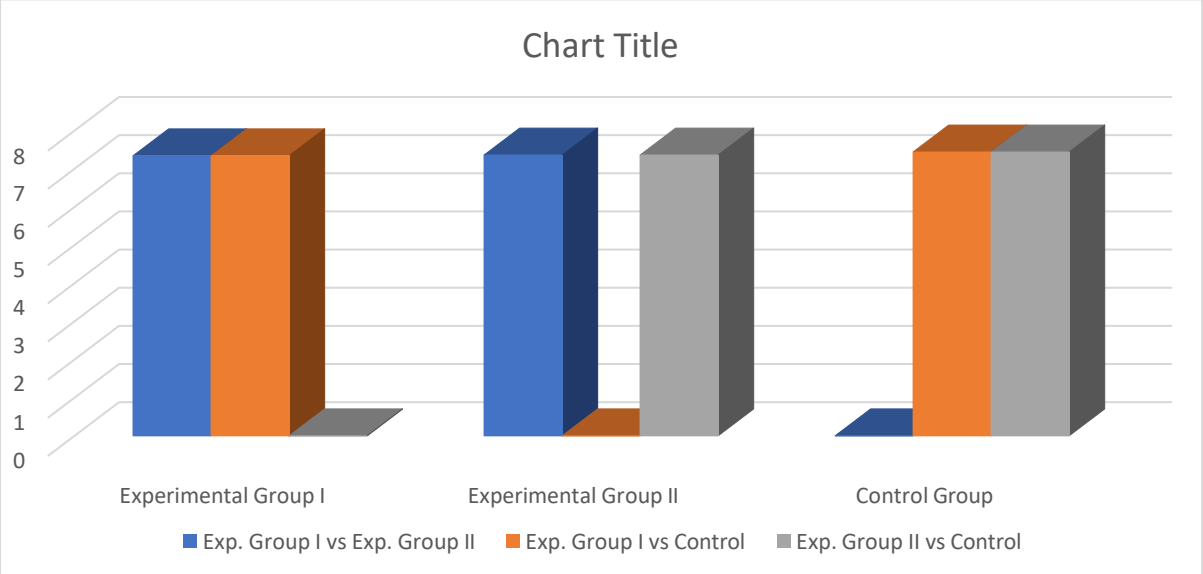
After the eight-week training program, the analysis of covariance showed that the three groups had very different speeds. The modified post-test means showed that both Circuit Resistance Training (CRT) and Aerobic Circuit Resistance Training (ACRT) made early adult female volleyball players far faster than the control group, which only did regular practice. The CRT group (7.34 seconds) showed a little more improvement in explosive speed than the ACRT group (7.36 seconds), even though both groups were substantially faster than the control group (7.44 seconds). Post-hoc comparisons confirmed that all mean differences between groups were statistically significant at the 0.05 level. This shows that structured circuit-based training regimens work better than old-fashioned training methods. These findings are consistent with prior research indicating that resistance-oriented circuit training enhances neuromuscular efficiency and explosive performance, while aerobic conditioning resistance training (ACRT) promotes speed enhancement through the integration of muscular conditioning and aerobic capacity development (Vala & Chaudhari, 2025; Bompa & Haff, 2009). As a result, both CRT and ACRT are good ways for volleyball players to improve their quickness. CRT, on the other hand, tends to favor speed performance over short-distance sprints, whereas ACRT may provide a more even improvement in speed for repeated sprints and endurance-related activities.

TABLE 2
Post-Hoc Comparison of Speed Among Experimental Groups and Control Group (Mean Difference, Confidence Interval, Significance)

Comparison	*Experimental Group I*	*Experimental Group II*	*Control Group*	*Mean Difference*	*Confidence Interval*	*Significance*
Exp. Group I vs Exp. Group II	7.34	7.36	–	0.02	0.0226	*
Exp. Group I vs Control	7.34	–	7.44	0.10	0.0226	*
Exp. Group II vs Control	–	7.36	7.44	0.08	0.0226	*

*Significant at 0.05 level of confidence

Figure 2
Post-Hoc Comparison of Speed Among Experimental Groups and Control Group



The post-hoc comparison of the adjusted post-test means for speed showed that the groups were very different from each other in terms of speed. The CRT group (Exp. Group I, mean = 7.34 s) and the ACRT group (Exp. Group II, mean = 7.36 s) had a statistically significant difference of 0.02 seconds, with the CRT group doing the task a little faster than the ACRT group. This difference was statistically significant ($p < 0.05$). The experimental groups exhibited substantial improvements relative to the control group, with a mean time of 7.44 seconds. The CRT group was 0.10 seconds faster than the ACRT group, and the ACRT group was 0.08 seconds quicker. This difference was statistically significant ($p < 0.05$). These results show that both circuit training methods work to make you faster, although CRT seems to give you a small edge when it comes to explosive sprinting. This is probably because it focuses on strength-building exercises that also assist enhance power and coordination between the muscles and the brain. The results show that adding CRT to training programs can lead to more speed gains than ACRT. However, both methods are better than regular practice that doesn't contain specialized circuit training.

In conclusion

The research findings indicate that circuit-based training programs, whether strength-focused (CRT) or a combination of aerobic and resistance training (ACRT), effectively enhance speed performance in early adult female volleyball players. ACRT also made speed a lot better and may have further benefits for speed endurance and overall cardiovascular conditioning. While CRT caused minor improvements in explosive speed, ACRT caused speed increases that were a little more noticeable. Coaches and trainers can use these results to make training plans that are based on data that is specific to each position and that focus on speed and other performance traits. This will help players do their best in volleyball games.

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