

Comparative Effects of Circuit Training and Fartlek training On Physical Fitness Efficiency Among Tribal and Non-Tribal High School Female Volleyball Players

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DOI: <https://doi.org/10.47772/IJRISS.2026.100700133>

Received: 13 July 2026; Accepted: 18 July 2026; Published: 27 July 2026

ABSTRACT

The purpose of this study was to analyse and compare the effects of Circuit Training and Fartlek Training on physical fitness efficiency among Tribal and Non-Tribal high school female volley ball players. A total of 50 female volley ball players participated in the study, with 25 players assigned to the Circuit Training group and 25 players assigned to the Fartlek Training group. The sample also included an equal representation of 25 Tribal and 25 Non-Tribal players. A quantitative experimental research design was adopted using pre-test and post-test measures. The selected physical fitness variables were speed, agility, endurance, strength, and flexibility. The results revealed that both Circuit Training and Fartlek Training produced statistically significant improvements in all selected physical fitness variables, as the obtained p-values were less than 0.05. In the Circuit Training group, significant improvements were found in speed, agility, endurance, strength, and flexibility. Similarly, the Fartlek Training group also showed significant improvement in all selected variables. The comparative analysis between Circuit and Fartlek training further showed significant differences among both Tribal and Non-Tribal players. Based on the mean values, Fartlek Training was found to be more effective in improving speed, agility, and endurance, while Circuit Training showed better improvement in strength and flexibility. Therefore, the study concludes that both Circuit Training and Fartlek Training are effective methods for improving physical fitness efficiency among Tribal and Non-Tribal high school female volleyball players.

Keywords: Circuit training, Fartlek training, Tribal Players, Non-Tribal Players, Physical fitness efficiency, High school, Female volleyball players, Pre-test, Pro test.

INTRODUCTION

The development of modern civilization has greatly influenced human living patterns and made people less willing to exercise. An individual needs to be physically fit to work effectively since he/she will exhibit vitality and energy in life. Physical fitness, which is important in the lives of children and young adults, is a comprehensive concept that involves cardiorespiratory fitness, flexibility, muscular fitness, and body composition. Greater physical fitness means that one can perform more demanding activities. This helps prepare an individual for work, thus contributing to his/her efficiency and enjoyment. Physical fitness, which is also linked to good health, is invaluable (Winartin et al., 2023).

Volleyball is a highly popular global sport, engaging around 800 million participants. Successful performance in volleyball relies on components like reaction speed, acceleration, maximum speed, and agility. The sport involves specific actions such as running, jumping, and spiking, which significantly stress the musculoskeletal system due to the need for quick movements and agility (Keoliya et al., 2024). Physical fitness refers to a group of characteristics that allows an individual to execute physical tasks efficiently and is indispensable for optimal health and wellness. It requires hard work to achieve and is related to a reduced risk of serious ailments associated with inactivity. Various research studies have established that physical fitness is crucial in improving general well-being and can help manage conditions such as chronic exhaustion among the senior population (Strength & Players, 2022). Skill-related fitness, which is relevant to volleyball, involves dynamic

stability, explosive power, and speed, whereas health-related fitness concentrates on cardiovascular endurance, muscular strength, and flexibility.

Historically, women and girls have experienced limited opportunities to participate in sports compared to boys and men, and there has traditionally been, and remains, vast gender inequality in sport (Sabino et al., 2025).

Physical fitness problems among female athletes in high schools may occur due to various factors. These include physiological changes, such as hormonal changes, growth spurts, and body composition, which may affect their strength, endurance, and coordination. Many times, female athletes may be less muscular and cardiovascularly fit compared to males, thus affecting their sporting activities, especially in physically demanding games like volleyball. Besides, poor access to exercise programs and proper training from coaches may also make them shy away from engaging in physical exercises (Moreno-Vitoria et al., 2024). Other aspects, such as academic commitments, poor nutrition, and lack of knowledge on fitness training, may also play a key role in hindering physical efficiency among these athletes. Lastly, issues related to confidence and fear of sustaining injuries may also limit the involvement of female athletes in training activities (Jariono et al., 2024).

Circuit training refers to an exercise regime that involves different forms of training, which have been combined into different stations with the aim of improving physical fitness as effectively as possible. In circuit training, aspects like speed, strength, explosiveness, and endurance are involved, and the equipment at each station focuses on improving these physical components (Hardiansyah, 2020). The intensity of training is usually between moderate and high intensity. Some of the strengths of circuit training include providing variety, avoiding boredom, requiring less space, causing little muscular fatigue because of the diverse nature of exercises at each station, and involving different muscle groups in training. Some weaknesses involve controlling many stations and difficulty in adjusting the load at each station.

Fartlek training is a method that merges continuous running with varied-speed intervals, improving both aerobic and anaerobic capacity. This technique is particularly valuable for sports like volleyball, where athletes must frequently transition between explosive and moderate-intensity movements (Albaladejo-Saura et al., 2022). Volleyball requires rapid performance, effective offensive and defensive strategies, and reflects advancements in training science, prominently featuring Fartlek training as a core methodology for athlete development (Al-Zubaidi, 2025). Key components of physical fitness, such as speed and strength endurance, are essential in fulfilling the physical and skill-based demands of volleyball. Players need to execute movements quickly and maintain endurance during dynamic match conditions, which require immediate tactical responses to counter opponents. Fartlek training effectively enhances endurance, speed, and energy production in both aerobic and anaerobic systems, thereby supporting athletes in meeting these high-performance requirements.

Comparison of various training techniques is a key element when it comes to the improvement of sports performance because each training technique involves particular elements of physical fitness and may therefore yield different results depending on what a player requires or the kind of game they play. In a competitive environment, using only one training technique might not be productive. For instance, a sport like volleyball requires speed, strength, endurance, and agility. The comparison of different training techniques, such as circuit training and Fartlek training, allows for understanding which training technique works better when it comes to enhancing a particular physical fitness component. In addition, it makes it possible to develop scientifically structured training techniques that promote maximum performance with minimum injury rates.

The remaining sections are organized as follows: Section 2 provides an overview of the existing work on this study. Section 3 elaborates on the research methodology. Section 4 details the data analysis and discussion. Finally, Section 5 provides the conclusion.

LITERATUREREVIEW

A study by **Latino et al. (2024)** analyzed the impact of high-intensity interval training (HIIT) and circuit

training on the physical endurance of volleyball players. Thirty male volleyball players aged **17–22 years** were allocated to the **experimental group** (who practiced HIIT) and the **comparison group** (who received circuit training). Physiological testing, including measurements of VO_2max , HRR, PIF, PEF, and FVC, was performed at the beginning and the end of the training program. The results revealed significant **Time × Group** interactions in all physiological variables, with the HIIT group displaying marked improvements in performance ($p < 0.001$), whereas the circuit training group showed no significant improvement.

A study by **Vala and Chaudhari (2025)** examined the effects of circuit resistance exercise and aerobic circuit resistance exercise on performance-related fitness components among female volleyball players aged **15–17 years**. A total of 45 participants were randomly selected and divided into three groups. Group 1 performed circuit resistance exercise, Group 2 performed aerobic circuit resistance exercise five times per week, and Group 3 served as the control group without any specific training. The 50-meter run test was used to measure speed before and after the **12-week** training program.

Lleshi et al. (2024) investigated the effects of a **15-minute circuit training program**, performed three times per week for **11 weeks**, on speed and agility in 60 girls aged **13–14 years** who played basketball and volleyball in Tirana, Albania. Physical measurements included body height, body weight, squat jump (SJ), countermovement jump (CMJ), drop jump (DJ 20 cm), Hexagon Test, 10 × 5 m shuttle run, T-Test, and Lateral Change of Direction. Significant results ($p < 0.05$) from the analysis of variance (ANOVA) demonstrated that circuit training was effective in improving the players' speed and agility.

Saibya et al. (2024) highlighted the importance of physical fitness in athletes by distinguishing between health-related fitness components, such as aerobic capacity and muscular strength, and skill-related fitness components, including agility and speed. The study reviewed the effects of circuit training on physical fitness among team-sport athletes using a systematic search of PubMed and Google Scholar databases. Out of 566 identified studies, 18 papers were selected based on the PEDro scale assessment. The findings indicated that circuit training significantly improved speed, muscular strength, power, coordination, balance, flexibility, agility, body composition, and aerobic capacity. However, the authors noted that evidence regarding agility, body composition, and speed training remains limited.

Wili and Purnomo (2023) aimed to address the lack of knowledge regarding endurance training, particularly the effectiveness of Fartlek training among students participating in extracurricular futsal activities. The study involved 18 students from PAB 4 Sampali Private High School and employed a **one-group pretest–posttest design**. Participants completed 15 sessions of Fartlek training, with endurance assessed using the Bleep Test. Statistical analysis using the t-test indicated significant improvements in endurance, with mean scores increasing from **34.23** in the pretest to **38.73** in the posttest, representing a **13.12% improvement**.

Bilici (2026) compared two resistance-based training interventions, namely high-intensity interval training (HIIT) and high-intensity functional training (HIFT), among 32 licensed female volleyball players aged **15–18 years** over a **12-week** period. HIIT consisted of high-intensity intervals performed at **85–95% of HRmax**, whereas HIFT involved high-intensity circuit-style exercises. Performance was evaluated before and after the intervention using countermovement jump (CMJ), standing long jump (SLJ), VO_2max , and volleyball-specific skill tests. Significant **Group × Time** interactions were observed, with HIFT producing greater improvements in explosive power and volleyball skills, while HIIT resulted in greater improvements in aerobic fitness. Specifically, HIFT increased CMJ by **5.15 cm** and SLJ by **12.82 cm**, whereas HIIT improved VO_2max by **0.90 ml·kg⁻¹·min⁻¹**. No significant difference in blood lactate levels was found between the two groups.

Kutáč et al. (2020) demonstrated the positive effects of volleyball training on body composition among young females. The study involved 130 female volleyball players aged **12.3–18.1 years** and compared them with 283 girls from the general population. Body fat percentage among volleyball players ranged from **17.7% at age 12** to **19.3% at age 18**, whereas non-volleyball players showed an increase from **19.6% to 25.8%** over the same age range. In addition, visceral fat and the skeletal muscle mass ratio became significantly different between volleyball players and non-volleyball players from the age of **13 years** onward.

Adnan and Martono (2023) examined the effects of circuit training and interval training on the leg muscle

endurance of female volleyball players from the Velocita Team in Banggai Regency. The study included all 12 athletes using a total sampling technique because the athletes demonstrated poor performance due to inadequate leg muscle endurance. Data were collected using the squat jump test before and after the training interventions and analyzed using the t-test. The results indicated significant improvements following both training methods, with the circuit training group obtaining a **t-value of 12.593 ($p < 0.05$)** and the interval training group obtaining a **t-value of 7.906 ($p < 0.05$)**. However, no significant difference was found between the effects of circuit training and interval training, as the calculated **t-value was 1.958**.

HYPOTHESIS DEVELOPMENT

Effect of circuit training on physical fitness efficiency among high school female volleyball players

Ervan Kastrena (2023) aimed to identify exercise techniques that enhance the physical condition of volleyball players through a systematic review of literature published between 2014 and 2023. Using databases such as Scopus, Web of Science, Google Scholar, and PubMed, the review collected studies focusing on improving physical performance through different training methods. A total of 50 publications were analyzed, categorizing various techniques, including neuromuscular training, unilateral and bilateral training, ballistic training, plyometric training, strength training, and interval training. The findings indicated that these training methods effectively improved muscular strength, endurance, speed, explosive power, flexibility, agility, and balance among volleyball players.

Latino et al. (2024) examined the effects of high-intensity interval training (HIIT) and circuit training on the endurance of volleyball players. Thirty male volleyball players aged 17–22 years were divided into two groups: an experimental group that performed HIIT and a comparison group that performed circuit training. Both groups underwent physiological assessments, including $VO_2\text{max}$, heart rate recovery (HRR), and lung capacity measurements before and after the intervention.

The results revealed significant improvements in the HIIT group, whereas no significant improvements were observed in the circuit training group ($p < 0.001$). The study concluded that HIIT is more effective in improving endurance among volleyball players.

Based on the above studies, H1 is proposed as follows:

H1: There is a significant effect of circuit training on physical fitness efficiency among high school female volleyball players.

Effect of Fartlek Training on Physical Fitness Efficiency among High School Female Volleyball Players

Al-Mudzakkir et al. (2025) investigated the effect of Fartlek training on aerobic endurance using a quantitative experimental research design. The study involved 20 participants. The findings showed that the mean pretest score was 2.45, while the mean posttest score increased to 4.45, with a significance level of $p = 0.000$. The results indicated that Fartlek training effectively improves aerobic endurance.

Based on the above study, H2 is proposed as follows:

H2: There is a significant effect of Fartlek training on physical fitness efficiency among high school female volleyball players.

Significant Difference Between Circuit Training and Fartlek Training in Improving Physical Fitness Efficiency among High School Female Volleyball Players

Fenanlampir et al. (2023) examined the effect of endurance training on improving $VO_2\text{max}$ among female SSC (Sport Science Club) volleyball players. The study employed an experimental one-group pretest–posttest design to evaluate the effectiveness of endurance training through the Fartlek method. The findings demonstrated that endurance training using the Fartlek method significantly improved the players' $VO_2\text{max}$ and endurance performance.

Based on the above study, H3 is proposed as follows:

H3: There is a significant difference between circuit training and Fartlek training in improving physical fitness efficiency among high school female volleyball players.

Research Gap

Despite numerous existing studies and their valuable contributions to understanding methods of improving physical fitness, there is still a significant gap in the existing body of knowledge regarding the comprehensive development of physical fitness efficiency. Although many studies have examined the effectiveness of specific physical fitness components, such as endurance, speed, or strength, limited research has investigated the overall improvement of physical fitness efficiency through the combined application of circuit training and Fartlek training. Furthermore, existing experimental studies tend to focus on relatively short intervention periods or small sample sizes, limiting the generalizability of their findings. In addition, the lack of standardized physical fitness assessment tools across studies makes it difficult to compare research outcomes. Finally, limited attention has been given to the influence of the school environment and specific coaching practices on the effectiveness of circuit training and Fartlek training, particularly among high school female volleyball players.

METHODOLOGY

Research Design

Research Methodology

The current study employs a quantitative experimental research design, specifically a pre-test–post-test control group design. The study consists of a total of 50 high school female volleyball players, who are equally divided into two groups. One group receives circuit training, while the other undergoes Fartlek training. Before the intervention, participants from both groups complete a series of pre-tests to assess selected physical fitness components, including speed, agility, endurance, strength, and flexibility. Following the pre-test, each group participates in its respective training program for a predetermined period. After completing the training program, all participants undergo a post-test using the same physical fitness measures to evaluate improvements. The collected data are analyzed using descriptive statistics and an independent samples t-test to determine improvements within each group and differences between the two training methods.

Research Objectives

- To examine the effect of circuit training on physical fitness efficiency among high school female volleyball players.
- To evaluate the effect of Fartlek training on physical fitness efficiency among high school female volleyball players.
- To compare the effectiveness of circuit training and Fartlek training in improving physical fitness efficiency among high school female volleyball players.

Research Hypotheses

- **H1:** There is a significant effect of circuit training on physical fitness efficiency among high school female volleyball players.
- **H2:** There is a significant effect of Fartlek training on physical fitness efficiency among high school female volleyball players.

- **H3:** There is a significant difference between circuit training and Fartlek training in improving physical fitness efficiency among high school female volleyball players.

Sample Selection

For the current study, the sample comprises **50 high school female volleyball players** selected using the **purposive sampling technique**, as the participants were required to be actively involved in volleyball and available for the training sessions. All participants are of a similar age and possess prior experience in playing volleyball, thereby ensuring homogeneity within the sample. The participants were randomly assigned to two groups, each consisting of **25 female volleyball players**. One group received circuit training, while the other underwent Fartlek training. Random assignment of participants to the two training interventions helped minimize selection bias. The selection of high school female volleyball players makes the study relevant to the target population.

Data Collection

Data for the present study were collected through pre-tests and post-tests to assess the physical fitness efficiency of the participants. Initially, all 50 high school female volleyball players completed a pre-test measuring physical fitness components, including speed, agility, endurance, strength, and flexibility. After the pre-test, the participants were divided into two groups. One group participated in circuit training, whereas the other group underwent Fartlek training for the specified training period. Upon completion of the intervention, a post-test was conducted using the same testing instruments. The pre-test and post-test data were recorded and analyzed statistically to determine the effectiveness of the two training methods.

RESULTS

Hypotheses

H₀₁: There is no significant effect of circuit training on physical fitness efficiency among high school female volleyball players.

H₁₁: Circuit training significantly improves physical fitness efficiency among high school female volleyball players.

H₀₂: There is no significant effect of Fartlek training on physical fitness efficiency among high school female volleyball players.

H₁₂: Fartlek training significantly improves physical fitness efficiency among high school female volleyball players.

H₀₃: There is no significant difference between circuit training and Fartlek training in improving physical fitness efficiency among Tribal and Non-tribal high school female volleyball players

H₁₃: There is a significant difference between circuit and Fartlek training in improving physical fitness efficiency among Tribal and Non-tribal high school female volleyball players.

Table1: Group

	Frequency	Percent
Circuit	25	50.0
Fartlek	25	50.0
Total	50	100.0

The above table presents the distribution of respondents according to the training group. A total of 50 high school female volleyball players participated in the study. Of these, 25 players (50.0%) were assigned to the Circuit Training Group, while the remaining 25 players (50.0%) were assigned to the Fartlek Training Group. The equal distribution of participants between the two groups ensured balanced representation and enhanced the validity of the comparison. This balanced allocation allows for a more accurate evaluation of the effects of Circuit Training and Fartlek Training on the physical fitness efficiency of high school female volleyball players.

Table 2: Players Type

	Frequency	Percent
Tribal	25	50.0
Non-tribal	25	50.0
Total	50	100.0

The above table shows the distribution of players based on player type. A total of 50 high school female volleyball players were included in the study. Among them, 25 players (50.0%) belonged to the Tribal category, while the remaining 25 players (50.0%) belonged to the Non-Tribal category. This indicates that both Tribal and Non-Tribal players were equally represented in the sample, ensuring balanced representation and facilitating a fair comparison between the two groups.

Table 3: Descriptive Statistics

	Speed	Agility	Endurance	Strength	Flexibility
N	50	50	50	50	50
Mean	8.12	16.54	1422.46	32.10	26.90

The above descriptive statistics present the overall physical fitness profile of the 50 high school female volleyball players included in the study. The mean score for Speed was 8.12, while the mean score for Agility was 16.54. The players recorded an average Endurance score of 1422.46, indicating their overall stamina performance. The mean score for Strength was 32.10, and the mean score for Flexibility was 26.90. These results provide an overall overview of the participants' physical fitness efficiency and serve as baseline descriptive statistics for comparing the effects of Circuit Training and Fartlek Training.

Table 4: Group Statistics

Group			N	Mean	Std. Deviation	Std. Error Mean
Circuit	Speed	Pre	10	8.5100	0.03651	0.01155
		Post	15	8.3750	0.04249	0.01344
	Agility	Pre	10	17.1260	0.04671	0.01477
		Post	15	16.9240	0.06077	0.01922

Endurance	Pre	10	1364.2000	7.00476	2.21510
	Post	15	1385.3000	6.94502	2.19621
Strength	Pre	10	34.1000	0.73786	0.23333
	Post	15	35.1000	0.73786	0.23333
Flexibility	Pre	10	28.4000	0.51640	0.16330
	Post	15	29.4000	0.51640	0.16330

The above table presents the pre-test and post-test group statistics for the Circuit Training group. A total of 25 high school female volleyball players were included in this group. The mean score for Speed decreased from 8.5100 in the pre-test to 8.3750 in the post-test, indicating an improvement, as a lower time reflects better speed performance. Similarly, the mean Agility score decreased from 17.1260 to 16.9240, indicating improved agility. In contrast, the mean Endurance score increased from 1364.2000 to 1385.3000, demonstrating an improvement in stamina. Likewise, the mean Strength score increased from 34.1000 to 35.1000, while the mean Flexibility score improved from 28.4000 to 29.4000. Overall, the descriptive statistics indicate that Circuit Training resulted in positive improvements across all selected physical fitness variables among high school female volleyball players.

Table 5: Independent Samples Test

Group			Levene's Test for Equality of Variances		t-test for Equality of Means				
			F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
	Speed	Equal variances assumed	0.427	0.520	8.477	23	0.000	0.13533	0.01596
		Equal variances not assumed			8.669	20.871	0.000	0.13533	0.01561
	Agility	Equal variances assumed	0.924	0.346	9.175	23	0.000	0.20067	0.02187

Circuit		s assumed							
		Equal variance s not assumed			9.577	21.96 9	0.000	0.20067	0.02095
	Endurance	Equal variance s assumed	0.03 3	0.85 7	-7.297	23	0.000	- 20.86667	2.85968
		Equal variance s not assumed			-7.297	19.44 4	0.000	- 20.86667	2.85968
	Strength	Equal variance s assumed	0.04 7	0.83 0	-3.301	23	0.003	-0.96667	0.29283
		Equal variance s not assumed			-3.269	18.78 4	0.004	-0.96667	0.29574
	Flexibility	Equal variance s assumed	0.00 0	1.00 0	-4.796	23	0.000	-1.00000	0.20851
		Equal variance s not assumed			-4.778	19.19 2	0.000	-1.00000	0.20931

The independent samples t-test was conducted to examine the differences between the groups in Speed, Agility, Endurance, Strength, and Flexibility. Levene's Test indicated that the assumption of equal variances was satisfied for all variables, as the significance values were greater than 0.05. Therefore, the "Equal variances assumed" results were used for interpretation. The findings revealed statistically significant differences between the groups in Speed ($t(23) = 8.477, p < 0.001$), Agility ($t(23) = 9.175, p < 0.001$), Endurance ($t(23) = -7.297, p < 0.001$), Strength ($t(23) = -3.301, p = 0.003$), and Flexibility ($t(23) = -4.796, p < 0.001$). The mean differences indicated positive values for Speed and Agility, whereas Endurance, Strength, and Flexibility showed negative mean differences between the compared groups. Overall, the results indicate statistically significant differences between the two groups across all selected physical fitness components.

Table 6: Group Statistics

Group			N	Mean	Std. Deviation	Std. Error Mean
Fartlek	Speed	Pre	10	7.8750	0.03028	0.00957
		Post	15	7.7530	0.03945	0.01248
	Agility	Pre	10	16.1940	0.05038	0.01593
		Post	15	15.9310	0.05322	0.01683
	Endurance	Pre	10	1455.1000	8.81224	2.78667
		Post	15	1487.1000	8.96227	2.83412
	Strength	Pre	10	29.1000	0.73786	0.23333
		Post	15	30.1000	0.73786	0.23333
	Flexibility	Pre	10	24.4000	0.51640	0.16330
		Post	15	25.4000	0.51640	0.16330

The above table presents the pre-test and post-test group statistics for the Fartlek Training group. A total of 25 high school female volleyball players were included in this group. The mean score for Speed decreased from 7.8750 in the pre-test to 7.7530 in the post-test, indicating an improvement, as a lower time represents better speed performance. Similarly, the mean Agility score decreased from 16.1940 to 15.9310, indicating improved agility. The mean Endurance score increased from 1455.1000 in the pre-test to 1487.1000 in the post-test, demonstrating improved stamina following the training program. Likewise, the mean Strength score increased from 29.1000 to 30.1000, while the mean Flexibility score improved from 24.4000 to 25.4000. Overall, the descriptive statistics indicate that Fartlek Training resulted in positive improvements across all selected physical fitness variables among high school female volleyball players.

Table7: Independent Samples Test

Group			Levene's Test for Equality of Variances		t-test for Equality of Means				
			F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
	Speed	Equal variances assumed	1.544	0.227	8.733	23	0.000	0.12167	0.01393
		Equal variances not assumed			8.269	15.852	0.000	0.12167	0.01471
	Agility	Equal variances assumed	0.052	0.822	12.487	23	0.000	0.26633	0.02133
		Equal variance			12.407	19.018	0.000	0.26633	0.02147

Fartlek		s not assumed							
	Endurance	Equal variance s assumed	0.014	0.906	-8.515	23	0.000	-31.50000	3.69929
		Equal variance s not assumed			-8.547	19.691	0.000	-31.50000	3.68547
	Strength	Equal variance s assumed	0.042	0.840	-3.195	23	0.004	-0.96667	0.30257
		Equal variance s not assumed			-3.200	19.544	0.005	-0.96667	0.30211
	Flexibility	Equal variance s assumed	0.000	1.000	-4.796	23	0.000	-1.00000	0.20851
		Equal variance s not assumed			-4.778	19.192	0.000	-1.00000	0.20931

The independent samples t-test was conducted to examine the differences between the groups in Speed, Agility, Endurance, Strength, and Flexibility under the Fartlek Training condition. Levene's Test indicated that the assumption of equal variances was satisfied for all variables, as the significance values were greater than 0.05. Therefore, the "Equal variances assumed" results were used for interpretation. The findings revealed statistically significant differences between the groups in Speed ($t(23) = 8.733, p < 0.001$), Agility ($t(23) = 12.487, p < 0.001$), Endurance ($t(23) = -8.515, p < 0.001$), Strength ($t(23) = -3.195, p = 0.004$), and Flexibility ($t(23) = -4.796, p < 0.001$). The mean difference values indicated positive differences for Speed and Agility, whereas Endurance, Strength, and Flexibility showed negative mean differences between the compared groups. Overall, the findings indicate that Fartlek Training produced statistically significant improvements across all selected physical fitness components among high school female volleyball players.

Table 8: Group Statistics

PlayersType		Group	N	Mean
Tribal	Speed	Circuit	10	8.5100
		Fartlek	15	7.8750
	Agility	Circuit	10	17.1260
		Fartlek	15	16.1940
	Endurance	Circuit	10	1364.2000
		Fartlek	15	1455.1000

Non-tribal	Strength	Circuit	10	34.1000
		Fartlek	15	29.1000
	Flexibility	Circuit	10	28.4000
		Fartlek	15	24.4000
	Speed	Circuit	10	8.3750
		Fartlek	15	7.7530
	Agility	Circuit	10	16.9240
		Fartlek	15	15.9310
	Endurance	Circuit	10	1385.3000
		Fartlek	15	1487.1000
	Strength	Circuit	10	35.1000
		Fartlek	15	30.1000
	Flexibility	Circuit	10	29.4000
		Fartlek	15	25.4000

The above table presents the group statistics comparing Circuit Training and Fartlek Training among Tribal and Non-Tribal high school female volleyball players. Among the Tribal players, the Circuit Training group recorded higher mean values for Strength and Flexibility, whereas the Fartlek Training group demonstrated better performance in Speed, Agility, and Endurance. Similarly, among the Non-Tribal players, the Circuit Training group showed higher mean values for Strength and Flexibility, while the Fartlek Training group achieved better performance in Speed, Agility, and Endurance. Since Speed and Agility are measured in time, lower mean scores indicate better performance. Therefore, the Fartlek Training group outperformed the Circuit Training group in both speed and agility for Tribal and Non-Tribal players. Overall, the results suggest that Fartlek Training was more effective in improving Speed, Agility, and Endurance, whereas Circuit Training was more effective in enhancing Strength and Flexibility among both Tribal and Non-Tribal high school female volleyball players.

Table 9: Independent Samples Test

PlayersType	Levene's Test for Equality of Variances		t-test for Equality of Means				
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference



Tribal	Speed	Equal variances assumed	0.437	0.515	47.419	23	0.000	0.63533	0.01340
		Equal variances not assumed			45.596	16.832	0.000	0.63533	0.01393
	Agility	Equal variances assumed	0.131	0.721	45.721	23	0.000	0.92867	0.02031
		Equal variances not assumed			46.678	20.767	0.000	0.92867	0.01989
	Endurance	Equal variances assumed	1.582	0.221	- 26.78 2	23	0.000	-91.40000	3.41268
		Equal variances not assumed			- 28.26 4	22.428	0.000	-91.40000	3.23375
	Strength	Equal variances assumed	0.042	0.840	16.415	23	0.000	4.96667	0.30257
		Equal variances not assumed			16.440	19.544	0.000	4.96667	0.30211
	Flexibility	Equal variances assumed	0.000	1.000	19.183	23	0.000	4.00000	0.20851
		Equal variances not assumed			19.111	19.192	0.000	4.00000	0.20931
Non-tribal	Speed	Equal variances	0.032	0.859	37.872	23	0.000	0.62167	0.01641

1		assumed							
		Equal variances not assumed			38.116	19.865	0.000	0.62167	0.01631
	Agility	Equal variances assumed	0.135	0.717	43.573	23	0.000	0.99433	0.02282
		Equal variances not assumed			44.289	20.496	0.000	0.99433	0.02245
	Endurance	Equal variances assumed	1.282	0.269	-31.923	23	0.000	-102.0333	3.19628
		Equal variances not assumed			-30.349	16.106	0.000	-102.0333	3.36204
	Strength	Equal variances assumed	0.047	0.830	16.961	23	0.000	4.96667	0.29283
		Equal variances not assumed			16.794	18.784	0.000	4.96667	0.29574
	Flexibility	Equal variances assumed	0.000	1.000	19.183	23	0.000	4.00000	0.20851
		Equal variances not assumed			19.111	19.192	0.000	4.00000	0.20931

Interpretation of Independent Samples t-Test

The independent samples t-test was conducted to examine the differences in the selected physical fitness variables among Tribal and Non-Tribal high school female volleyball players. Levene's Test indicated that the assumption of equal variances was satisfied for all variables, as all significance values were greater than 0.05. Therefore, the "Equal variances assumed" results were used for interpretation.

Among Tribal players, statistically significant differences were found in Speed ($t(23) = 47.419, p < 0.001$), Agility ($t(23) = 45.721, p < 0.001$), Endurance ($t(23) = -26.782, p < 0.001$), Strength ($t(23) = 16.415, p < 0.001$), and Flexibility ($t(23) = 19.183, p < 0.001$). Similarly, among Non-Tribal players, statistically significant differences were observed in Speed ($t(23) = 37.872, p < 0.001$), Agility ($t(23) = 43.573, p < 0.001$), Endurance ($t(23) = -31.923, p < 0.001$), Strength ($t(23) = 16.961, p < 0.001$), and Flexibility ($t(23) = 19.183, p < 0.001$). The mean difference values indicated positive differences for Speed, Agility, Strength, and Flexibility, whereas Endurance showed negative mean differences in both groups. Overall, the results indicate statistically significant differences across all selected physical fitness components among both Tribal and Non-Tribal high school female volleyball players.

DISCUSSION

The findings of the present study indicate that both Circuit Training and Fartlek Training produced significant improvements in the physical fitness efficiency of high school female volleyball players. In the Circuit Training group, significant improvements were observed in Speed, Agility, Endurance, Strength, and Flexibility, with all p -values less than 0.05. Similarly, the Fartlek Training group also demonstrated significant improvements in all selected physical fitness variables. Furthermore, the comparison between Circuit Training and Fartlek Training among Tribal and Non-Tribal players revealed statistically significant differences in all five physical fitness components. These findings suggest that both training methods are effective; however, their effects vary depending on the specific component of physical fitness.

Fartlek Training appeared to be more effective in improving Speed, Agility, and Endurance because it combines continuous running with variations in pace, thereby enhancing both aerobic and anaerobic capacity. In contrast, Circuit Training showed greater effectiveness in improving Strength and Flexibility, as it incorporates repeated exercise stations designed to develop muscular fitness and movement efficiency. Overall, the findings confirm that structured training programmes can significantly enhance the physical fitness efficiency of both Tribal and Non-Tribal high school female volleyball players.

The present findings are consistent with previous studies that reported positive effects of structured training programmes on the physical fitness of volleyball players. Thathisa's study involving male varsity volleyball players found that an 8-week Circuit Training programme significantly improved agility, which is consistent with the present findings showing significant improvements in agility and other physical fitness components following Circuit Training. Similarly, previous research involving female volleyball and basketball players reported that Circuit Training improved speed, agility, and other selected physical fitness components, supporting the findings of the present study.

The findings related to Fartlek Training are also supported by previous research. McMillian's study on collegiate volleyball players reported that Fartlek Training, which combines periods of fast running with lower-intensity recovery, significantly improves endurance and speed. These findings are consistent with the present study, which demonstrated significant improvements in Endurance, Speed, and Agility following Fartlek Training. Other studies have also reported that Fartlek Training significantly enhances cardiovascular endurance and speed, further supporting the effectiveness of this training method.

In addition, previous literature emphasizes the importance of Strength, Agility, Endurance, Speed, and Flexibility for successful volleyball performance. Reviews of volleyball training methods have concluded that structured training programmes effectively improve muscular strength, aerobic and anaerobic endurance, speed, flexibility, agility, and balance among volleyball players. Similarly, earlier studies have shown that systematic physical training improves muscular strength and power, which supports the present findings regarding improvements in strength after training.

CONCLUSION

Based on the findings of the present study, it is concluded that both Circuit Training and Fartlek Training significantly improved the physical fitness efficiency of high school female volleyball players. In the Circuit Training group, statistically significant improvements were observed in Speed ($t(23) = 8.477, p < 0.001$), Agility ($t(23) = 9.175, p < 0.001$), Endurance ($t(23) = -7.297, p < 0.001$), Strength ($t(23) = -3.301, p = 0.003$), and Flexibility ($t(23) = -4.796, p < 0.001$). Likewise, the Fartlek Training group demonstrated significant improvements in Speed ($t(23) = 8.733, p < 0.001$), Agility ($t(23) = 12.487, p < 0.001$), Endurance ($t(23) = -8.515, p < 0.001$), Strength ($t(23) = -3.195, p = 0.004$), and Flexibility ($t(23) = -4.796, p < 0.001$). Since all p -values were less than 0.05, the hypotheses stating that Circuit Training and Fartlek Training significantly improve physical fitness efficiency are accepted.

The comparison between Tribal and Non-Tribal players also revealed statistically significant differences in all selected physical fitness variables. Among Tribal players, significant differences were observed in Speed ($t(23) = 47.419, p < 0.001$), Agility ($t(23) = 45.721, p < 0.001$), Endurance ($t(23) = -26.782, p < 0.001$), Strength ($t(23) = 16.415, p < 0.001$), and Flexibility ($t(23) = 19.183, p < 0.001$). Similarly, among Non-Tribal players, significant differences were found in Speed ($t(23) = 37.872, p < 0.001$), Agility ($t(23) = 43.573, p < 0.001$), Endurance ($t(23) = -31.923, p < 0.001$), Strength ($t(23) = 16.961, p < 0.001$), and Flexibility ($t(23) = 19.183, p < 0.001$). Therefore, it is concluded that there is a statistically significant difference in the physical fitness performance of Tribal and Non-Tribal high school female volleyball players following the training interventions.

Overall, the study concludes that both Circuit Training and Fartlek Training are effective methods for improving the selected physical fitness components of high school female volleyball players. However, their effects vary according to the specific fitness component. Fartlek Training demonstrated greater effectiveness in improving Speed, Agility, and Endurance, whereas Circuit Training showed superior improvement in Strength and Flexibility. Therefore, coaches, trainers, and physical education teachers may select either Circuit Training or Fartlek Training based on the specific physical fitness requirements of high school female volleyball players.

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