EFFECT OF PILATES TRAINING ON BODY COMPOSITION AND FITNESS VARIABLES OF MALE VOLLEYBALL PLAYERS

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ABSTRACT

The study aims to investigate the effect of Pilates training on the Body composition (Percentage body fat, BMI, Fat-free mass, Skeletal Muscle Mass) of male volleyball players. The research includes thirty recreationally active volleyball players from the various Departments of the Central University of Punjab as subjects. The subjects were randomly assigned to two equal groups of 15 each. A random sampling technique was employed for the study, as it is most appropriate. An experimental research design was used in the study. The ages of the subjects ranged from 18 to 25 years. Group I was undergoing Pilates training, while Group II acted as the control. ANCOVA was used to determine the significant difference existing between pre-test and post-test on body composition variables. The result of the study proved that the effect of Pilates training improved the body composition (Percentage body fat, BMI, Fat-free mass, Skeletal Muscle Mass) of male volleyball players**.**

Keywords: Pilates training, Body composition

INTRODUCTION

PILATES TRAINING

Pilates is a mind-body exercise system with roots stretching back to the early twentieth century, born from the ingenuity and personal determination of its creator, Joseph Hubertus Pilates. To understand the method fully, one must first understand the remarkable life and circumstances that gave rise to it for the system is inseparable from the man who devised it, shaped as it was by his personal experiences of illness, war, and an unrelenting commitment to the study of human movement (Latey, 2001). Joseph Pilates was born in 1883

in Monchengladbach, Germany. As a child, he suffered from rickets, asthma, and rheumatic fever conditions that left him physically frail and deeply motivated to improve his own body. Rather than accepting weakness, he immersed himself in the study of various physical disciplines, including gymnastics, boxing, martial arts, skiing, and diving. He was also profoundly influenced by ancient Greek philosophy, which held that the ideal of human life was the harmonious development of mind, body, and spirit in equal measure.

According to Pilates Anytime, "Studying a wide range of exercise and movement methods, including the Greek philosophy of mind, body, and spirit, Joseph Pilates was inspired to develop a movement system to strengthen his own body. While imprisoned at an English internment camp during World War I, he began training others in his system called The Art of Contrology."[1] This wartime period was particularly formative. Pilates worked with interned patients who were bedridden, attaching springs to their hospital beds so that they could exercise in a supine position an improvisation that would later become the conceptual basis for the Reformer machine.

VOLLEYBALL

Initially known as 'Mintonette,' Volleyball was introduced by William G. Morgan in 1895 at the YMCA in Holyoke, Massachusetts. The game was spread to Europe and around the globe during World War I and turned into a formally recognized game after World War II when the International Federation was established. Volleyball was called Mintonette as a result of its similarity to badminton. Later, Alfred Halstead renamed volleyball because the game aimed to volley the ball back over a net. Advanced volleyball is profoundly spent significant time on practically all the considerable skills of volleyball. It is a game for young and older adults. The character of volleyball is not quite the same as that of different game disciplines. The rotation framework is a one-of-a-kind element that separates volleyball from other games (Reeser & Bahr, 2003).

METHODOLOGY

In this chapter, the selection of subjects, selection of variables, selection of tests, reliability of data, orientation to the subjects, pilot study, training program, training schedule, collection of the data, administration of the tests, and experimental design and statistical procedure used have been explained.

SELECTION OF SUBJECT

The researcher selected thirty recreationally active volleyball players from the various departments of the Central University of Punjab as subjects. The subjects were randomly assigned to two equal groups of 15 each. A random sampling technique was employed for the study. An experimental research design was used in the study. The ages of the subjects ranged from 18 to 25 years. Group I underwent Pilates training, while Group II acted as the control group.

SELECTION OF VARIABLES

The following variables are selected after going through critical and allied literature related to the study, and considering feasibility criteria for conducting such a study

Independent variable

- Pilates training

Dependent fitness variables

1. Percentage body fat 2. BMI 3. Fat-free mass 4. Skeletal Muscle Mass

TRAINING PROGRAMME

The experimental group received intensive training three days a week for eight weeks during the training phase. the workout lasted about 45 minutes, including warm-up and cool-down. Aside from their activities, the control group did not engage in any specific training regimen or physically demanding activities.

Pilates training protocol

Exercises	I & II week	III & IV week	V & VI week	VII &VIII week
Leg circle	2x10	2x15	3x10	3x15
Scissors	2x10	2x15	3x10	3x15
Sidekicks	2x10	2x15	3x10	3x15
The saw	2x10	2x15	3x10	3x15
Spine stretch	2x10	2x15	3x10	3x15
Single leg stretch	2x10	2x15	3x10	3x15
Heel squeeze	2x10	2x15	3x10	3x15
Roll over		2x15	3x10	3x15
Shoulder bridge			3x10	3x15

ADMINISTRATION OF TEST

Body Composition Analyzer - Charder is used to measure body composition. Bioelectrical Impedance analysis (BIA) machines measure the resistance of electrical flow through the body. It assessed on percentage of body fat, BMI, fat-free mass, and skeletal muscle mass.

STATISTICAL TECHNIQUE

The normality of the data was assessed using the Shapiro–Wilk test. Data collected from both groups before and after the experiment on the selected dependent variables were analyzed using analysis of covariance (ANCOVA) to determine whether significant differences existed. The level of statistical significance was set at 0.05 for all analyses.

RESULT

The study aimed to ascertain how body composition parameters were affected by pilates training. Thirty participants and fifteen members in each group were selected as study subjects to fulfill the study's objectives.

ASSUMPTION OF NORMALITY

The Shapiro-Wilk test is used to check the normality of the data. Using the analysis of covariance (ANCOVA), the data gathered from the two groups before and after training were statistically examined to identify any significant differences.

Table 1. Shapiro–Wilk Statistic

Variable	Shapiro–Wilk Statistic	p-value	Result
Pre pbf	0.975	0.696	Normal
Post pbf	0.972	0.587	Normal
Pre bmi	0.978	0.767	Normal
Post bmi	0.961	0.329	Normal
Pre ffm	0.975	0.687	Normal
Post ffm	0.984	0.917	Normal
Pre smm	0.991	0.994	Normal
Post smm	0.983	0.896	Normal

Table 4.1 The Shapiro–Wilk test results indicated that all variables had p-values greater than 0.05, suggesting that the data were normally distributed. Therefore, the assumption of normality was satisfied, allowing the use of the parametric statistical technique ANCOVA.

Table 2. ANALYSIS OF COVARIANCE ON THE PERCENT BODY FAT OF PILATES TRAINING AND CONTROL GROUPS

	Pilates Training Group	**Control Group**	**SOV**	**Sum of Squares**	**df**	**Mean squares**	**'F' ratio**
Pre test Mean SD	17.88 2.57	17.52 1.96	B W	0.93 146.99	1 28	0.93 5.25	0.17
Post test Mean SD	17.40 2.67	17.52 1.90	B W	0.09 151.51	1 28	0.09 5.41	0.01
Adjusted Post test Mean	17.93	17.47	B W	1.61 1.94	1 27	1.61 0.07	22.38

*Significant at .05 level of confidence

(The required table value for significance at 0.05 level of confidence with degrees of freedom 1 and 27 is 4.21, and degree of freedom 1 and 28 is 4.20.)

At pre-test, the Pilates training group mean value is 17.88, and the standard deviation value is 2.57; the control group mean value is 17.52, and the standard deviation value is 1.96 on Percent body fat. Pilates training and control groups obtained 'F' ratio value is 0.17; this is lower than the fixed table value of 4.20. It shows that there is no significant difference between the pilates training and control groups at the pre-test level on percent body fat.

At post-test, the Pilates training group mean value is 17.40 and standard deviation value is 2.67; the control group mean value is 17.52, and standard deviation value is 1.90 on percentage body fat. Pilates training and control groups obtained 'F' ratio value is 0.01; this is lower than the fixed table value of 4.20. It shows that there is no significant difference between the pilates training and control groups at the post-test level on percentage body fat.

At the adjusted post-test, the pilates training group mean value is 17.93, and the control group

mean value is 17.47 on percentage body fat. Pilates training and control groups obtained 'F' ratio value is 22.38; this is higher than the fixed table value of 10.85. It shows that there is a significant difference between the pilates training and control groups at the adjusted post-test level on percentage body fat.

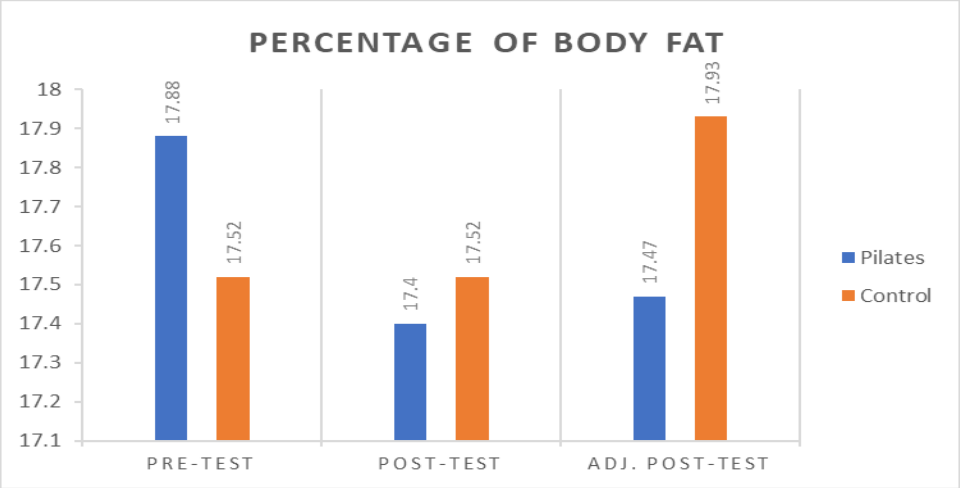

Figure-1 diagram of the data on the percentage body fat of experimental and control groups

Table 3. ANALYSIS OF COVARIANCE ON THE BODY MASS INDEX OF PILATES TRAINING AND CONTROL GROUPS

	PILATES Training Group	**Control Group**	**SOV**	**Sum of Squares**	**df**	**Mean squares**	**'F' ratio**
Pre test Mean	21.36	21.31	B	0.02	1	0.02	0.006
SD	2.29	1.50	W	105.31	28	3.76	
Post test Mean	20.98	21.12	B	0.14	1	0.14	0.05
SD	1.88	1.49	W	81.20	28	2.90	
Adjusted Post test Mean	21.44	21.23	B	0.32	1	0.32	1.23
			W	7.02	27	0.26	

*Significant at .05 level of confidence

(The required table value for significance at 0.05 level of confidence with degrees of freedom 1 and 27 is 4.21, and degree of freedom 1 and 28 is 4.20.)

At pre-test, the Pilates training group mean value is 21.36, and the standard deviation value is 2.29; the control group mean value is 21.31, and the standard deviation value is 1.50 on BMI. Pilates training and control groups obtained 'F' ratio value of 0.006; this is lower than the fixed table value of 4.20. It shows that there is no significant difference between the pilates training and control groups at the pre-test level on BMI.

At post-test, the Pilates training group mean value is 20.98 and standard deviation value is 1.88; the control group mean value is 1.49, and standard deviation value is 1.90 on BMI. Pilates training and control groups obtained 'F' ratio value of 0.05; this is lower than the fixed table value of 4.20. It shows that there is no significant difference between the pilates training and control groups at the post-test level on BMI.

At the adjusted post-test, the pilates training group mean value is 21.44, and the control group mean value is 21.23 on BMI. Pilates training and control groups obtained 'F' ratio value is 1.23; this is lower than the fixed table value of 10.85. It shows that there is no significant difference between the pilates training and control groups at the adjusted post-test level on BMI.

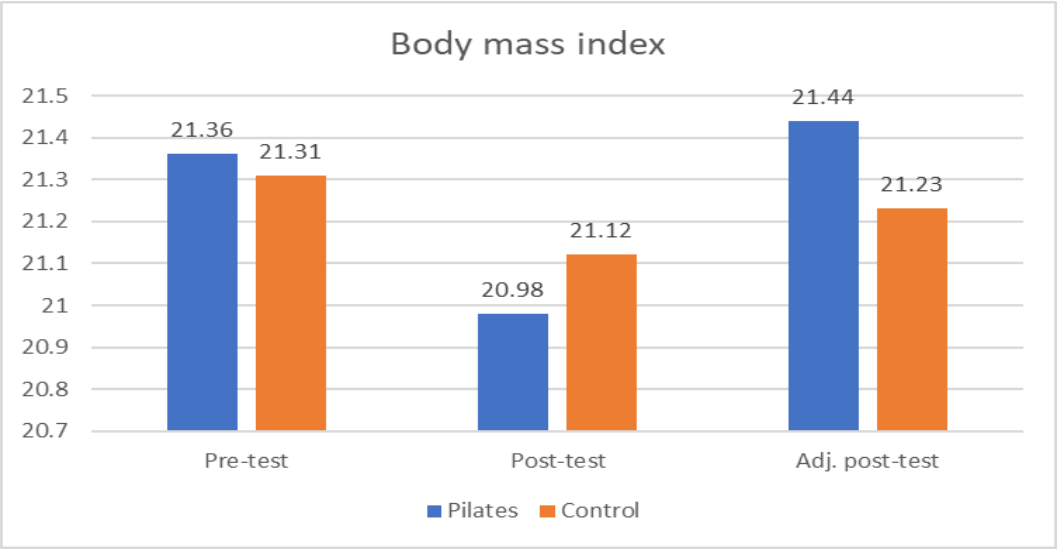

Figure-2 diagram of the data on the BMIof experimental and control groups

Table 4. ANALYSIS OF COVARIANCE ON THE FAT FREE MASS OF PILATES TRAINING AND CONTROL GROUPS

	Pilates Training Group	Control Group	SOV	Sum of Squares	df	Mean squares	'F' ratio
Pre test Mean	60.40	58.08	B	40.13	1	40.13	4.57
SD	3.04	2.87	W	245.93	28	8.78	
Post test Mean	60.64	57.93	B	54.94	1	54.94	6.2
SD	2.95	2.98	W	247.66	28	8.84	
Adjusted Post test Mean	59.05	59.42	B	0.83	1	0.83	7.99
			W	2.81	27	0.10	

*Significant at .05 level of confidence

(The required table value for significance at 0.05 level of confidence with degrees of freedom 1 and 27 is 4.21, and degree of freedom 1 and 28 is 4.20.)

At pre-test, the Pilates training group mean value is 60.40, and the standard deviation value is 3.04; the control group mean value is 58.08, and the standard deviation value is 2.87 on fat free mass. Pilates training and control groups obtained 'F' ratio value is 4.57; this is higher than the fixed table value of 4.20. It shows that there is a significant difference between the pilates training and control groups at the pre-test level on fat free mass.

At post-test, the Pilates training group mean value is 60.64 and standard deviation value is 2.95; the control group mean value is 57.93, and standard deviation value is 2.98 on fat free mass. Pilates training and control groups obtained 'F' ratio value is 6.2; this is higher than the fixed table value of 4.20. It shows that there is a significant difference between the pilates training and control groups at the post-test level on fat free mass.

At the adjusted post-test, the pilates training group mean value is 59.05, and the control group mean value is 59.42 on fat free mass. Pilates training and control groups obtained 'F' ratio

value is 7.99; this is lower than the fixed table value of 10.85. It shows that there is no significant difference between the pilates training and control groups at the adjusted post-test level on fat free mass

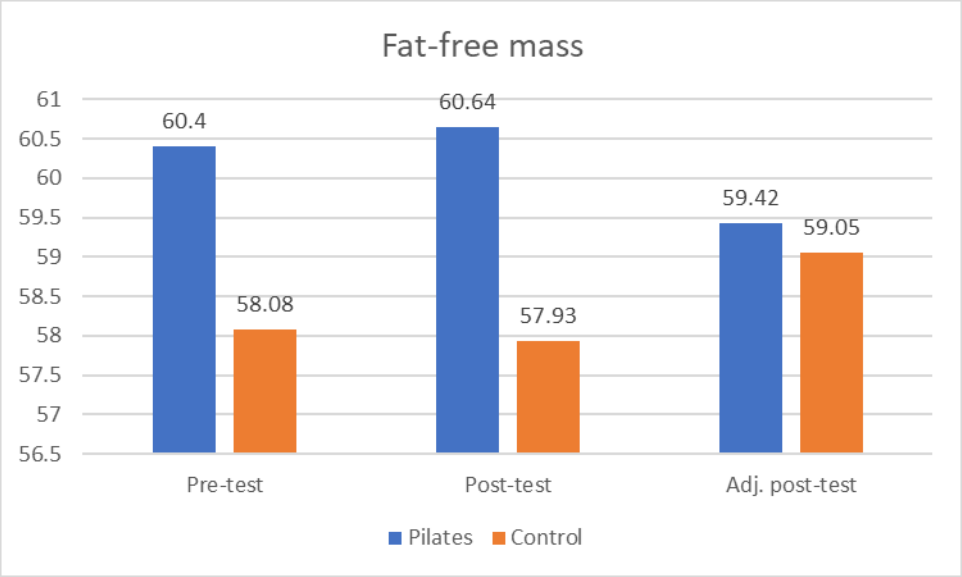

figure 4 diagram of the data on the fat free mass of experimental and control groups

Table 5. ANALYSIS OF COVARIANCE ON THE SKELETAL MUSCLE MASS OF PILATES TRAINING AND CONTROL GROUPS

	Pilates Training Group	**Control Group**	**SOV**	**Sum of Squares**	**df**	**Mean squares**	**'F' ratio**
Pre test Mean	29.91	28.72	B	1.12	1	1.12	0.19
SD	3.00	1.58	W	161.29	28	5.76	
Post test Mean	29.25	28.58	B	13.46	1	13.46	2.29
SD	2.96	1.72	W	164.64	28	5.88	
Adjusted Post test Mean	28.45	29.37	B	5.84	1	5.84	30.70
			W	5.14	27	0.19	

*Significant at .05 level of confidence

(The required table value for significance at 0.05 level of confidence with degrees of freedom 1 and 27 is 4.21, and degree of freedom 1 and 28 is 4.20.)

At pre-test, the Pilates training group mean value is 29.91, and the standard deviation value is 3.00; the control group mean value is 28.72, and the standard deviation value is 1.58 on skeletal muscle mass. Pilates training and control groups obtained 'F' ratio value is 0.19; this is lower than the fixed table value of 4.20. It shows that there is no significant difference between the pilates training and control groups at the pre-test level on skeletal muscle mass.

At post-test, the Pilates training group mean value is 29.25 and standard deviation value is 2.96; the control group mean value is 28.58, and standard deviation value is 1.72 on skeletal muscle mass. Pilates training and control groups obtained 'F' ratio value is 2.29; this is lower than the fixed table value of 4.20. It shows that there is no significant difference between the pilates training and control groups at the post-test level on skeletal muscle mass.

At the adjusted post-test, the pilates training group mean value is 28.45, and the control group mean value is 29.37 on skeletal muscle mass. Pilates training and control groups obtained 'F' ratio value is 30.70; this is higher than the fixed table value of 10.85. It shows that there is a significant difference between the pilates training and control groups at the adjusted post-test level on skeletal muscle mass.

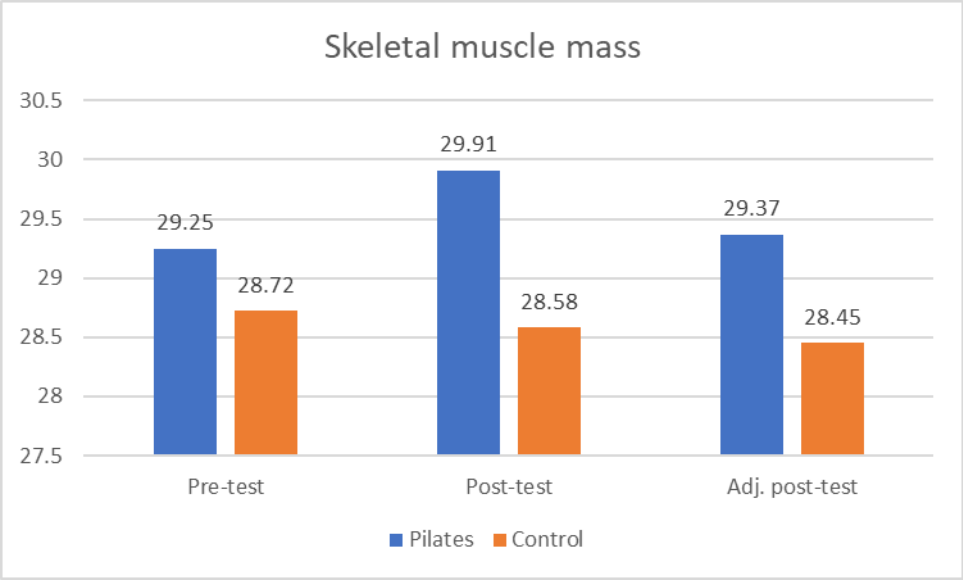

Figure 5 diagram of the data on the skeletal muscle mass of experimental and control groups

DISCUSSION ON FINDINGS

The result of the study indicates that eight weeks of Mat Pilates training induced a significant decrease in body fat percentage of the experimental group volleyball players when compared to the control group. The following studies are strengthening the present results. Rogers and Gibson (2005) found that consistent Pilates training produces measurable reductions in body fat percentage through the interplay between increased lean tissue and improved metabolic efficiency. Lust et al. (2003) determined that Pilates-based interventions significantly altered body composition in active individuals, with fat mass showing the most notable reductions. Segal et al. (2004) "These physiological changes align perfectly with recent systematic reviews demonstrating the profound efficacy of Pilates in reducing adipose tissue while simultaneously building functional muscle mass (Pereira et al., 2022; Sanaa Ali Ahmed, 2023) examined the effects of Pilates training on body composition and concluded that regular participation in Pilates leads to significant improvements in fat percentage, particularly among individuals engaged in sport-specific training programmes.

2. Body Mass Index (BMI)

The result of the study indicates that eight weeks of Mat Pilates training did not induce a significant change in BMI of the experimental group volleyball players when compared to the control group. The following studies are strengthening the present results. Greco et al. (2019) found that body composition improvements from Pilates-based training frequently go undetected by BMI measures, as simultaneous gains in muscle mass offset reductions in fat mass, leaving total body weight relatively stable. Kloubec (2010) determined that Pilates training produced meaningful internal changes in body composition without corresponding changes in BMI, confirming the limitation of BMI as a sole measure of training adaptation. Cruz-Ferreira et al. (2011) examined the effects of Pilates-based exercise on body composition and concluded that BMI alone is insufficient to capture the full extent of physical changes occurring during Pilates interventions, and must be interpreted alongside more sensitive measures.

3. Fat Free Mass (FFM)

The result of the study indicates that eight weeks of Mat Pilates training induced a significant increase in fat-free mass of the experimental group volleyball players when compared to the control group. The following studies are strengthening the present results.

Cheryl et al. (2012) found that Pilates movements targeting the core and limbs require muscles to work against bodyweight resistance through controlled ranges of motion, generating sufficient mechanical tension to stimulate lean tissue development. Kloubec (2010) determined that Pilates training produced statistically significant gains in muscular endurance and lean mass, confirming its capacity as a genuine tissue-building stimulus. Emery et al. (2010) examined the effects of a Pilates training programme on body composition and concluded that fat free mass increased significantly in the experimental group, reflecting meaningful structural adaptation in response to the Pilates protocol.

4. Skeletal Muscle Mass (SMM)

The result of the study indicates that eight weeks of Mat Pilates training induced a significant increase in skeletal muscle mass of the experimental group volleyball players when compared to the control group. The following studies are strengthening the present results. Dorado et al. (2012) found that Pilates training, through its systematic engagement of the powerhouse musculature, produces significant gains in skeletal muscle mass, particularly in the core and lower limb regions. Fernandez-Rodríguez et al. (2021) determined that a structured Pilates programme led to measurable increases in skeletal muscle mass among active participants, with adaptations extending throughout the kinetic chain. Bullo et al. (2015) examined the effects of Pilates exercise on muscular development and concluded that skeletal muscle mass increases significantly following consistent Pilates training, supporting its use as a strength-building modality in sports performance contexts. Furthermore, improving leanness and neuromuscular power through targeted lean mass development is a documented fundamental adaptation required for highly trained volleyball athletes undergoing rigorous conditioning (Sheppard & Newton, 2012).

CONCLUSIONS

Based on the statistical analysis of the data, the following conclusions were drawn:

BODY FAT PERCENTAGE

A statistically significant reduction in body fat percentage was observed in the experimental group, with a post-test F-ratio of 22.38. The resistance-based nature of Mat Pilates stimulated lean tissue development, which in turn elevated the metabolic activity of

the athletes' bodies and contributed to a meaningful reduction in stored fat. For volleyball players, this shift translates into an improved power-to-weight ratio an advantage that compounds across every jump, sprint, and directional change throughout a match.

BODY MASS INDEX (BMI)

BMI did not change significantly between the experimental and control groups, returning a post-test F-ratio of 1.23. Rather than representing a shortcoming of the programme, this finding reflects the simultaneous and opposing changes occurring beneath the surface fat tissue decreasing while lean muscle mass was increasing. Since muscle is denser than fat, these changes largely cancelled each other out in terms of overall body weight, leaving BMI unchanged while the body's internal composition was substantially reorganized. It is a finding that cautions against over-reliance on BMI as a sole indicator of physical change.

FAT FREE MASS (FFM)

Fat-free mass increased significantly in the experimental group, with a post-test F-ratio of 7.99 exceeding the critical value of 4.21. This result confirmed that the Pilates protocol generated a training stimulus strong enough to promote genuine growth in lean structural tissue muscle, bone, and connective tissue combined. The athletes emerged from the eight-week programme with a more robust physical foundation, better equipped to produce force, absorb impact, and sustain the physical demands of competitive volleyball.

SKELETAL MUSCLE MASS (SMM)

Skeletal muscle mass produced the second strongest result in the study, with a post-test F-ratio of 30.70 a figure that rose from a non-significant pre-test value of 0.19 and exceeded the critical threshold by an exceptional margin. This dramatic shift confirmed that Mat Pilates, when applied consistently over eight weeks, functioned as a genuine functional strength-building tool. The growth in voluntary muscle mass enhanced the athletes' movement control, power generation, and overall physical resilience on the court.

RECOMMENDATIONS

On the basis of the findings of this study and the questions that naturally arise from them, the following recommendations are offered for researchers, coaches, and practitioners who wish to build on this work:

1. The present study was conducted over a period of eight weeks. Future research should explore whether extending the Pilates intervention to twelve or sixteen weeks produces proportionally greater gains, or whether the rate of adaptation plateaus after an initial period of rapid change. A longer timeline would also allow for a more thorough examination of how different variables respond at different stages of training.

2. The subjects in this study were male volleyball players between the ages of 18 and 25. It would be worthwhile to investigate whether similar results can be replicated in female volleyball players, or in younger junior athletes, where the neuromuscular system may respond differently to the same stimulus.

3. This study examined Mat Pilates in isolation. A natural next step would be to compare its effects against other training modalities such as yoga, conventional core training, or resistance-based programmes using the same variables and population, in order to better understand where Pilates sits within the broader landscape of athlete development tools.

4. Future studies should consider integrating Pilates training within a full in-season schedule to assess whether its benefits hold up, diminish, or even amplify when athletes are simultaneously managing the physical demands of regular competition and practice.

5. Performance-based outcomes such as vertical jump height, spike speed, and service accuracy were not included in this study. Subsequent investigations should bridge the gap between the physiological improvements documented here and the on-court performance metrics that ultimately matter most to coaches and athletes alike.

6. A follow-up assessment conducted several weeks after the end of the intervention would help establish how durable the gains from Pilates training actually are whether the improvements in balance, flexibility, endurance, and body composition are retained over time, or whether they require continuous training to be maintained.

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