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ORIGINAL ARTICLE

TO COMPARE EFFECTIVENESS OF PILATES TRAINING VERSUS PLYOMETRIC TRAINING ON BALANCE AND FITNESS AMONG VOLLEYBALL PLAYERS

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ABSTRACT

Background of the study: Balance and fitness are crucial for football performance impacting stability and injury prevention. This study compares the effects of Pilates and plyometric training on balance and fitness among footballers. In contrast plyometric training uses explosive exercises to balance and overall fitness. Both methods are effective, this research aims to evaluate and compare the effectiveness of Pilates and plyometric training. **Methodology**: The Study Design is Quasi-experiment and it is a type of Comparative study [Pre and Post]. Sampling Method is Random sampling method. This study conducted at Faculty of Physiotherapy, ACS Medical College and Hospital Campus, Dr. MGR Deemed University, Chennai. The study included 30 samples. Volleyball players with Age group of 18-25 years and Male players Outcome Measures are Balance, Coordination and Fitness. Measuring Tools used in the study are Y balance test and Sargent jump test. **Result**: Group A showed significant improvement in balance and quality of life with notable changes in Y balance test and Sargent test P value <0.0001. **Conclusion:** Plyometric training improves balance and fitness among volleyball players.

Keywords: Footballers, Pilates-training, Plyometric training, Balance, Fitness

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INTRODUCTION

Volleyball's globally popularity significantly improved players' physical fitness and overall preparedness coaches need to apply modern strategies to help players attain their full potential, while also gathering information about their players through ongoing development and monitoring. Volleyball is a dynamic and fast-paced game. Strength training for volleyball does not aim to enhance physical qualities for better performance. Volleyball players must prioritize strength training alongside other skills like agility, quickness, and endurance. When seeing a great volleyball player, the word 'quick' comes to mind. The players' movement is short and quick. Volleyball players must be able to quickly switch between vertical jump and point-saving digs, unlike other sports that need extensive sprints[1,2].

Plyometric training incorporates quick and explosives jumps, hopping, bounding and throws. The effectiveness of Plyometric training may very dependent on the design and duration of intervention[3]. This exercises aim to increase Power and speed by requiring muscle to exert maximal effort at a time. These exercise teaches how to move from muscle extension to contraction explosively, such as through repetitive jumping. Plyometric generally employed by athletes for performance enhancement, but also used in fitness to a lesser extent[4]. It train the muscles to stretch before jumping. Pre-stretching allows the muscles to store potential energy, which benefits in jumping higher. Plyometric workouts follow a precise sequence. The landing phase, the amortization phase, take off. During the landing phase the muscles begin to contract eccentrically. The quick eccentric contraction stretches the elastic component of the muscle, activating the stretch reflex. During the amortization phase it represents the time from landing to take off and is critical for power development. The takeoff is the concentric contraction that occurs after landing. During this phase elastic energy is utilized to improve jump high and explosives strength [5].

Pilate's technique is defined as exercises that help provide the proper form of the body without noticeable muscles and improve weak muscles. He sees it as an activity that helps extend the short muscles by focusing on one muscular set without producing tension in other muscles of the body. As a result, these exercises emphasize proper structure with a rationed breathing method, improving an individual's sense of body. One of the key elements of the Pilates technique is the correct breathing accompanying every exercise brings out the expansion of the two sides and the relaxation of abdominal muscles with breathing in and controlling the abdominal muscles and intensifying them towards the back with breathing out[6].

Pilates is a core stability training regimen that helps strengthen the neuromuscular system and protect the spine. This method combines core stabilizing exercises with mind and breath control challenges, using fluid movement throughout the body. Pilates focuses on core exercises and breathe control, activating muscles such as the transverse abdomen, diaphragm and pelvic floor. Incorporating these muscles helps stabilize the lumbar pelvic area. Pilates exercise has been shown to be

effective for health promotion, rehabilitation, and athletic performance[7].

Pilates enhances the strength, flexibility, and suppleness of the hip and shoulder muscles. Fluid and supportive movement through these joints reduces excessive torque on the spinal column. The Pilates program allows patients to identify and correct movement habits that may stress the spine, leading to more neutral alignment. Using proper focus and recognizing excessive strain can improve a patient's physical performance [8].

The Y-Balance Test (YBT), based on the Star Excursion Balance Test, is a cost-effective and objective measure for assessing lower extremity muscular strength, balance, and identifying asymmetries that could contribute to injury. The YBT-UQ, or Upper Quarter Y Balance Test, was created. An athlete's capacity to reach with their free hand while bearing weight on their contralateral upper limb can be quantitatively analysed using the YBT-UQ[9].

The Sargent jump, which essentially measures the difference between a person standing reach and the height to which he or she can jump and touch, is the basis for the majority of vertical-jump tests. The athlete performs the basic Sargent leap by standing facing a dark, smooth wall, both feet level on the ground, and toes contacting the wall. Then, using both hands, he or she reaches as high as they can and uses a piece of chalk or chalk dust to mark the wall (or a wall-mounted blackboard or jump board). The athlete jumps as high as they can while maintaining the proper jump position with their preferred side against the wall. At the top of the jump, they make another mark at the peak of the jump[10]. Jumping is a common competitive athletic activity that requires synchronization of various joints and muscles. Vertical jumping aims to lift the body's centre of mass (COM) as high as possible, with jump height influencing performance [11].

The vertical jump test can be conducted in a lab using jump platforms (JP) or in the field with the Sargent Jump Test (SJT) to assess explosive strength in lower limbs of athletes in various sports[12].

Balance training (BT) effectively improves several forms of balance performance [(14)].Pilates practice emphasizes deep breathing and balance. Several studies have found that Pilates activities improve balance and health markers in the elderly. Falls can occur when a person loses their balance or stumbles and is unable to get back on track. Therefore, before developing and assessing fall prevention techniques, it is essential to comprehend how the elderly's capacity to maintain balance has changed. Numerous training regimens are available to help older adults prevent falls and improve their balance, however multi-factor exercises are frequently found to be more successful. Pilates training is said to increase movement control, balance, stability, and flexibility while also strengthening the core muscles[13].

Physical fitness encompasses the ability to undertake activities requiring speed, endurance, strength, coordination, and flexibility[14]. Pilates synchronizes movement with breathing, improves general fitness, and improves mobility for daily activities. The systematic study found that physical training has a considerable favourable impact on various aspects of physical fitness, including

power, agility, speed, balance, and muscle strength[15].

Aim of study: The aim of the study is to find the effect of Pilates training versus Plyometric training on balance and fitness training among volleyball players.

Need of Study: This study aims to compare the effectiveness of Pilates training and Plyometric training on balance and fitness in volleyball players. Pilates enhance core strength, flexibility, and stability, which are crucial for balance and injury prevention. In contrast Plyometric training focuses on explosive power, agility, and speed , essential for quick movement and jumps in volleyball. By analysing their impact, this research will help coaches and athletes choose the most effective training method to enhance performance and reduce injury risk.

METHODOLOGY

The Study Design is Quasi-experiment and it is a type of Comparative study [Pre and Post]. Sampling Method is Random sampling method. This study conducted at Faculty of Physiotherapy, ACS Medical College and Hospital Campus, Dr. MGR Deemed University, Chennai. The study included 30 samples. Volleyball players with Age group of 18-25 years and Male players Outcome Measures are Balance, Coordination and Fitness. Measuring Tools used in the study are Y balance test and Sargent jump test.

Procedure: The study included male volleyball players and was randomly selected based on the inclusion criteria stiffness and tightness of muscles. They were divided into two groups. Group A (Pilates training) and Group B (Plyometric training), with 15 participants in each group. The study will span 6 months, with an 8-week intervention period. During the intervention, each group will engage in their respective training session for 30 minutes per session, 3 times per week. Pre and post-assessment will be conducted to measure improvement in balance and fitness, using standardized tests such as balance assessments, vertical jump test, and agility drills, Data Will be collected and analysed to compare the effectiveness of Pilates and Plyometric training on balance and fitness among the players.

GROUP: A Pilates

1. **Hundred Exercise**

The hundred is the classical Pilates warm-up exercise designed to activate the core, increase circulation and build endurance through rhythmic breathing and arm movements.

Steps

- Lie on back with knees bent and feet flat.
- Lift head, neck and shoulders off the mat.
- Extend arms alongside body, hovering above the mat. Pump arms up and down while inhaling for 5 counts.
- Repeat for 10 cycles (totally 100 counts).

2. **Roll-Up Exercise**

The roll-up is a Pilates mat exercise that strengthens the abdominal muscles and improve spinal flexibility by smoothy articulating the spine up and down through a controlled motion from lying to sitting and back.

Steps

- Lie flat with arms extended overhead.

- Inhale to prepare; exhale slowly roll up to a seated position, reaching towards toes.
- Inhale at the top; exhale roll down with control
- Repeat 5-10 times.

3. Single-Leg Circle Exercise

The single-leg circle is a core-strengthening Pilates exercise that enhance hip mobility and stability while challenging the abdominal muscles to keep the pelvis steady during circular leg movements.

STEPS

- Lie on back with one leg extended toward the ceiling and the other flat on the mat.
- Circle the raised leg across the body, down, and around, keeping hips stable.
- Perform 5 circles in each direction, then switch legs.

4. Glute Bridge

The glute bridge is a lower-body Pilates exercise targets the gluteal muscles, hamstrings, and lower back by lifting the hips off the ground while keeping the shoulders and feet grounded.

Steps

- Lie on back with knees bent and feet hip-width apart.
- Engage core and lift hips toward the ceiling.
- Hold for a few seconds, then lower hips back down.
- Repeat for 10-15 reps.

GROUP: B (Plyometric Training)

1. Side Lunge

A strength and mobility exercise targeting the inner and outer thighs, glutes, and hips. It improves lateral movement and balance.

STEPS

- Stand tall with feet hip-width apart.
- Take a wide step to the right, bending right knee and both feet flat on the ground.
- Keep the left leg straight and both feet flat on the ground. Push through the right foot to return to starting position.
- Repeat on the other side

2. Squat Jump

A plyometric move is that builds explosive power in the legs, targeting the quads, glutes, and calves.

Steps

- Stand with fee shoulder-width apart. Lower into a squat by bending knees and pushing hips back.
- Explode upward into a jump. Land softly, immediately lowering back into a jump.
- Repeat for 8-12 reps.

3.Single-Leg Hops

A unilateral plyometric exercise is that improves balance, ankle strength, and explosive power in each leg.

Steps

- Stand on one leg with the other slightly off the ground.
- Hop forward or in place using the standing leg.
- Landing softly, keeping balance.
- Repeat 8-10 hops, then switch legs.

5. Height Skips

An explosive skipping drill used to improve vertical power and coordination.

Steps

- Begin skipping, driving one knee up high while swinging the opposite arm.
- Push off the ground hard with each step to gain height.
- Land softly and repeat with alternating legs.
- Continue foe 20-30 meters or time-based interval

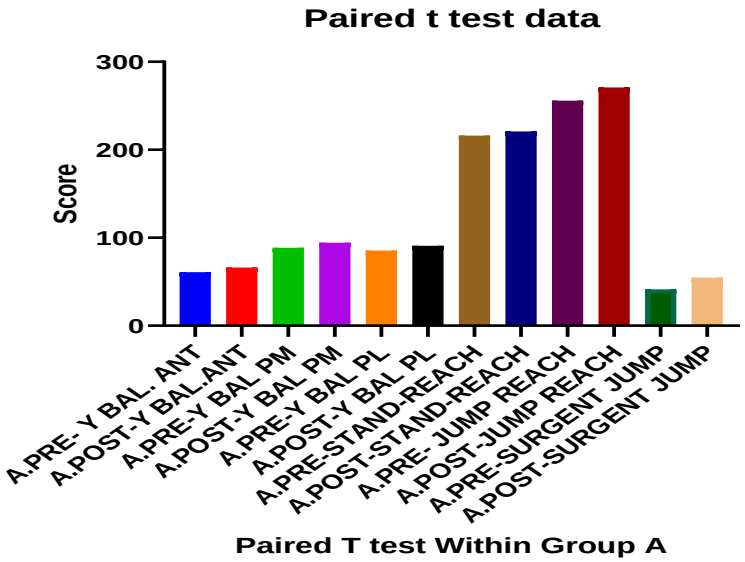
Data analysis: The collected data were tabulated and analyzed using both descriptive and inferential statistics. All the parameters were assessed using Graph Prism Pad version 8.4.3, with a significance level of p value less than 0.05 and a 95% confidence interval set for all analysis. The Shapiro Wilk test was used to determine the normality of the data. In this study, Shapiro Wilk test showed that the data was normally distributed on the dependent values at P > 0.05. Hence parametric test was adopted. Paired t-test was adopted to find the statistical difference within the groups & Independent t-test (Student t-Test) was adopted to find statistical difference between the groups.

Group A. Plyometric Exercise

Table 1: Paired t test within Group A on Y BAL. ANT, Y BAL PM, Y BAL PL, STAND-REACH, JUMP REACH and SURGENT JUMP

Group A	Number of Pairs	Mean Diff.	SD, SEM	df	t	P value	Sig. Diff. (P < 0.05)
Y BAL. ANT	15	5.22	1.55 0.40	14	13.3	<0.0001	****
Y BAL PM	15	5.77	6.56 1.69	14	3.14	<0.004	**
Y BAL PL	15	5.47	2.16 0.56	14	9.83	<0.0001	****
STAND-REACH	15	4.73	3.24 0.84	14	5.66	<0.0001	****
JUMP REACH	15	14.87	3.64 0.94	14	15.81	<0.0001	****
SURGENT JUMP	15	13.47	3.50 0.90	14	14.89	<0.0001	****

The above table 1 shows significant difference in Y BAL. ANT, Y BAL PM, Y BAL PL, STAND-REACH, JUMP REACH and SURGENT JUMP within Group A with P value <0.0001,<0.004 respectively.



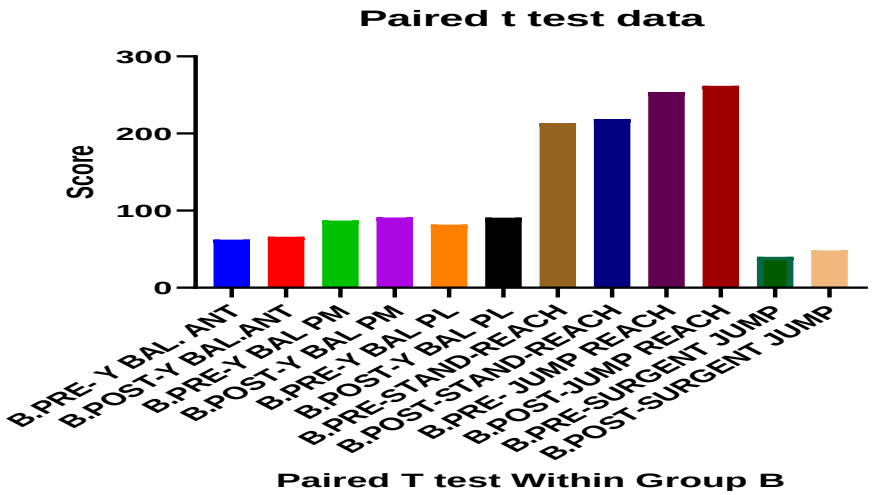
Graph 1: Presentation of Presentation of Y BAL. ANT, Y BAL PM, Y BAL PL, STAND-REACH, JUMP REACH and SURGENT JUMP within Group A

Group B. Pilates Exercise

Table 2: Paired t test within Group B on Y BAL. ANT, Y BAL PM, Y BAL PL, STAND-REACH, JUMP REACH and SURGENT JUMP

Group B	Number of Pairs	Mean Diff.	SD, SEM	df	t	P value	Sig. Diff. (P < 0.05)
Y BAL. ANT	15	3.72	5.42 1.40	14	2.66	<0.019	*
Y BAL PM	15	3.92	4.13 1.07	14	3.68	<0.003	**
Y BAL PL	15	8.84	3.51 0.91	14	9.76	<0.0001	****
STAND-REACH	15	5.20	2.01 0.52	14	10.03	<0.0001	****
JUMP REACH	15	8.13	2.70 0.70	14	11.69	<0.0001	****
SURGENT JUMP	15	8.20	2.70 0.70	14	11.74	<0.0001	****

The above table 2 shows significant difference in Y BAL. ANT, Y BAL PM, Y BAL PL, STAND-REACH, JUMP REACH and SURGENT JUMP within Group B with P value >0.0001



Graph 2: Presentation of Y BAL. ANT, Y BAL PM, Y BAL PL, STAND-REACH, JUMP REACH and SURGENT JUMP within Group B

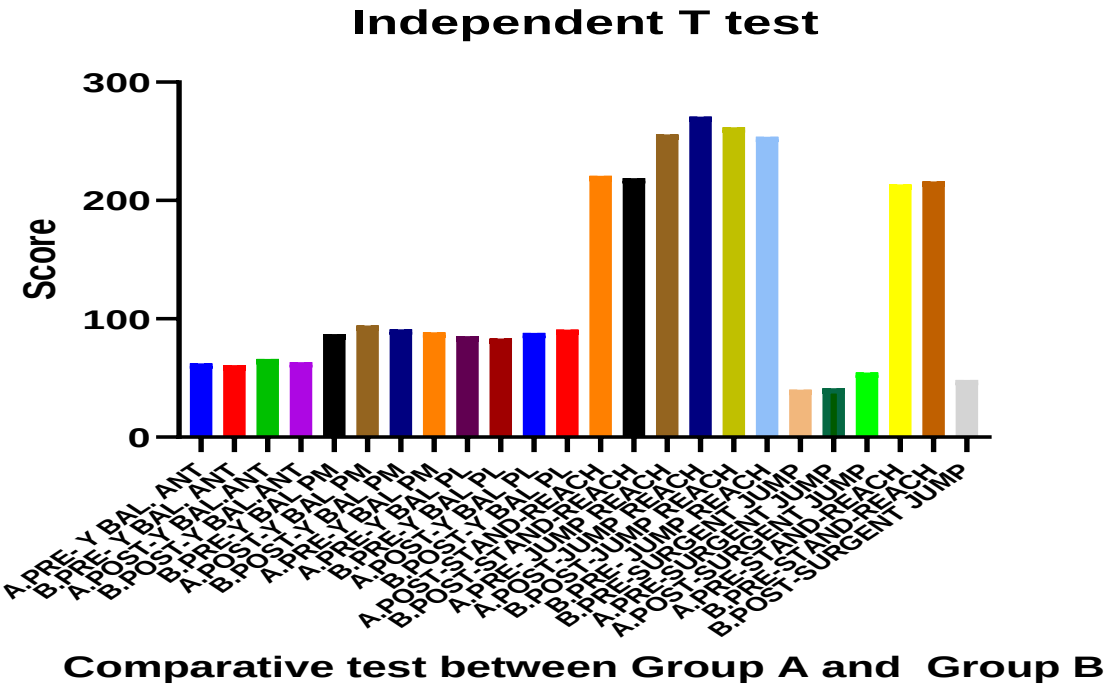
Comparative Test between Group A and Group B

Table 3: Independent t test between Group A and Group B

Group A&B		Number of Pairs	Mean Diff. ±SEM	R	DF	t	P value	Sig. Diff. (P < 0.05)
Pre test	Y BAL. ANT	30	1.50 1.35	0.04	28	1.11	0.275	NS
	Y BAL PM	30	1.39 1.60	0.03	28	0.87	0.391	NS
	Y BAL PL	30	2.03 1.10	0.11	28	1.86	0.073	NS
	STANDR EACH	30	2.40 1.22	0.12	28	1.97	0.059	NS
	JUMP REACH	30	2.13 1.44	0.07	28	1.48	0.150	NS
	SURGEN T JUMP	30	1.13 0.75	0.08	28	1.51	0.142	NS
Post test	Y BAL. ANT	30	2.78 0.95	0.24	28	2.94	0.007	**
	Y BAL PM	30	3.25 1.23	0.20	28	2.64	0.014	*
	Y BAL PL	30	2.59 1.23	0.14	28	2.10	0.045	*

	STAND-REACH	30	1.93 0.92	0.14	28	2.10	0.045	*
	JUMP REACH	30	8.87 1.70	0.49	28	5.23	0.0001	****
	SURGENT JUMP	30	6.47 1.37	0.44	28	4.71	0.0001	****

The above table 3 shows NO significant difference on Pre Test of Y BAL. ANT, Y BAL PM, Y BAL PL, STAND-REACH, JUMP REACH and SURGENT JUMP between Group A and Group B with P value 0.275, 0.391, 0.073, 0.059, 0.150, 0.142, Post Test of Y BAL. ANT, Y BAL PM, Y BAL PL, STAND-REACH, JUMP REACH and SURGENT JUMP between Group A and Group B, shows significance on P value with 0.007, 0.014, 0.045, 0.045, 0.0001 and 0.0001 respectively.



Graph 3: Presentation of Y BAL. ANT, Y BAL PM, Y BAL PL, STAND-REACH, JUMP REACH and SURGENT JUMP between Group A and Group B

RESULT

Total 30 participants of male subjects were included in the study based on specific selection criteria and divided in to 15 samples in each Group A and Group B. Participants were with age group between 18 and 24 years. In this study, the comparative effect of Group A over Group B on Y BAL. ANT, Y BAL PM, Y BAL PL, STAND-REACH, JUMP REACH and SURGENT JUMP shows significant difference with P value

with 0.007, 0.014, 0.045, 0.045, 0.0001 and 0.0001 respectively.

Group A plyometric training found effective on Y BAL. ANT, Y BAL PM, Y BAL PL, STAND-REACH, JUMP REACH and SURGENT JUMP with mean score difference of 5.22, 5.77, 5.47, 4.73, 14.87, and 13.47 respectively with P value <0.0001, <0.003, <0.0001, respectively.

Group B pilatestraining also found effective on Y BAL. ANT, Y BAL PM, Y BAL PL, STAND-REACH, JUMP REACH and SURGENT JUMP with mean score difference of 3.72, 3.92, 8.84, 5.20, 8.13, 8.20 respectively with P value <0.019, <0.003, <0.0001 respectively.

Group A plyometric training intervention found more effective over Group B intervention on Y BAL. ANT, Y BAL PM, Y BAL PL, STAND-REACH, JUMP REACH and SURGENT JUMP with mean score difference of 5.22, 5.77, 5.47, 4.73, 14.87, and 13.47 over 3.72, 3.92, 8.84, 5.20, 8.13, 8.20 respectively.

DISCUSSION

Volleyball is a dynamic and fast-paced game. Strength training for volleyball does not aim to enhance physical qualities for better performance. Volleyball players must prioritize strength training alongside other skills like agility, quickness, and endurance. Volleyball's globally popularity significantly improved players' physical fitness and overall preparedness coaches need to apply modern strategies to help players attain their full potential, while also gathering information about their players through ongoing development and monitoring .

Plyometric training incorporates quick and explosives jumps, hopping, bounding and throws. The effectiveness of Plyometric training may very dependent on the design and duration of intervention. This exercise to increase Power and speed by requiring muscle to exert maximal effort at a time. These exercises teach how to move from muscle extension to contraction explosively, such as through repetitive jumping. Plyometric generally employed by athletes for performance enhancement, but also used in fitness to a lesser extent It train the muscles to stretch before jumping. Pre-stretching allows the muscles to store potential energy.

This study aimed to compare the effectiveness of palates training versus plyometric training on balance and fitness training among volleyball players. Totally 30 collegiate volleyball players were randomly allocated into two equal group A (15) received plyometric training and Group B (15) underwent pilates training to compare their effectiveness on balance and fitness parameter over a structured 8-week intervention (3 sessions/week, 30 minutes/session). Volleyball players rely heavily on vertical jumps for net plays. Plyometric training directly targets the fast-twitch muscle fibers, which increases jump reach and allows athletes to perform higher and quicker jumps. Plyometric training plays a crucial role in enhancing the performance of volleyball players by focusing on explosive power, speed, agility, and coordination.

Plyometric exercise, which involves rapid, explosive movements like jumps, hops, and bounds are known to enhance the Strech-Shortening cycle (SSC) of muscles, resulting in increased power output, quicker

neuromuscular activation, and improved agility.

The Sargent vertical jump test also highlighted the effectiveness of plyometric training, with significant increase in vertical jump height observed post- intervention. This performance enhancement reflects the positive influence of plyometric drills on fast twitch muscle fiber activation, eccentric – concentric muscle efficiency, and overall lower-limb power-all essential for volleyball-specific task such as spiking, blocking and diving. These findings are consistent with Ana Filipa Silva, et al.,(2019) did a review on the effect of Plyometric training in volleyball players. this study concluded to better understand the benefits of this type of training for volleyball players overall performance[16].

A review on Effects of a 12-Week Pilates Program on Functional Physical Fitness and Basal Metabolic Rate in Community-Dwelling Middle-Aged Women This study concluded that The 12-week Pilates exercise program (Table S1) is practical to implement in communities to promote health and improve body composition, functional fitness, and basal metabolic rate, which may help to prevent age-associated frailty and reduce the risk of accidental falls in middle-aged women populations[17].

A review on the comparative study of effectiveness Plyometric and Pilates exercise on increasing vertical jump performance among basketball players. This study concluded that plyometric were showed effective in vertical jump height [18].

Review on the Effect of Plyometric versus Pilates exercise on the muscular ability and components of jumping to volleyball players: a comparative study. This study concluded that both groups (A and B) were effective in agility test, improving vertical jump height jump distance, the block jump, and the attack jump in volleyball players. But we used recommended Plyometric training in volleyball players[19,20].

This finding of present study demonstrated significant improvement in balance and fitness with y balance test and sergeant test. This study concludes that both Pilates training and plyometric training are effective for balance and fitness among volleyball players. When compare with Pilates training, plyometric training shows more effective because plyometric training has been showed greater effective in vertical jump height, balance, and fitness. Hence plyometric training is highly effective method for enhancing athletic performance particularly in volleyball.

Group A intervention found more effective over Group B intervention on Y BAL. ANT, Y BAL PM, Y BAL PL, STAND-REACH , JUMP REACH and SURGENT JUMP with mean score difference of 5.22, 5.77, 5.47, 4.73, 14.87, 13.47 over 3.72, 3.92, 8.84, 5,20, 8.13, 8.20 respectively.

Ethical Clearance: Ethical clearance has obtained from Faculty of Physiotherapy, Dr. MGR. Educational and Research Institute, Chennai, Tamil Nadu, India. Reference number: No: BPT IV Year-C Sec, 61/ PHYSIO/ IRB/ 2024-2025, dated: 16/12/ 2024.

Conflict of interest: There was no conflict of interest to conduct and publish this study.

Fund for the study: It was a self-financed study.

CONCLUSION

The study was concluded to compare the effectiveness of Pilates training and plyometric training on balance and fitness among volleyball players, using Y balance test and sargent jump test as outcome measures. After 8 weeks of intervention, both groups showed improvements; however, the group that underwent plyometric training exhibited significantly greater improvements in both balance and lower limb explosive strength. The plyometric group demonstrated a marked increase in jump height and reach, as well as enhanced dynamic balance across all directions in the Y balance test.

These results highlight the superior impact of plyometric exercise in improving neuromuscular coordination, power, and balance, which are critical components of volleyball performance. Therefore, it can be concluded that plyometric training is highly effective and practical method to enhance both balance and fitness in volleyball players, making it a valuable component in athletic conditioning programs.

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