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PLYOMETRIC TRAINING-INDUCED CHANGES IN PHYSICAL, PHYSIOLOGICAL, AND SKILL PERFORMANCE VARIABLES AMONG VOLLEYBALL PLAYERS

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ABSTRACT

The purpose of this study was to examine the plyometric training–induced changes in selected physical, physiological, and skill performance variables among volleyball players. A total of 40 volleyball players were randomly selected and divided into two equal groups: Group I served as the Plyometric Training Group (PTG), and Group II served as the Control Group (CG). The PTG underwent plyometric training three days per week for a period of twelve weeks, while the CG continued their routine activities without any additional training. A pilot study was conducted to determine the initial capacity of the subjects and to establish appropriate training loads. The selected physical variables included arm explosive power and leg explosive power; the physiological variable was breath-holding time, and the skill performance variable was spiking ability. These variables were measured before and after the twelve-week training period. Statistical analysis was performed using the t-test to determine the significance of the differences between the pre-test and post-test scores at the 0.05 level of confidence. The results revealed significant improvements in arm explosive power, leg explosive power, breath-holding time, and spiking ability among the participants in the plyometric training group. The findings indicate that plyometric training significantly improves selected physical, physiological, and skill performance variables among volleyball players. These results are consistent with previous research in the field of sports sciences, highlighting the effectiveness of plyometric training in enhancing volleyball performance.

INTRODUCTION

Volleyball is a dynamic and highly competitive sport that requires a combination of physical fitness, physiological efficiency, and technical skill for optimal performance. During a match, players frequently perform explosive movements such as jumping, blocking, spiking, and rapid directional changes. These movements demand well-developed physical qualities such as muscular power, speed, and agility, along with efficient physiological functioning. Therefore, the application of scientific and systematic training methods plays a crucial role in enhancing the performance of volleyball players.

Among various modern training methods, plyometric training has been widely recognized as an effective technique for improving explosive power and neuromuscular coordination. Plyometric exercises involve rapid stretching followed by an immediate contraction of the muscles, which enhances the stretch shortening cycle and increases muscular efficiency. According to **Donald A. Chu (1998),** plyometric training significantly improves muscular power and athletic performance in sports that involve jumping and explosive movements. Similarly, **Tudor O. Bompa (1999)** emphasized that specialized power training methods such as plyometrics are essential for developing sport-specific performance abilities. Furthermore, research by **William J. Kraemer and Steven J. Fleck (2004)** indicates that plyometric exercises contribute to improvements in both physical and physiological capacities of athletes, which in turn enhance sport-specific skills. Since volleyball performance heavily depends on explosive jumping and powerful spiking, plyometric training may play a vital role in improving these abilities. Therefore, the present study aims to examine the plyometric training-induced changes in selected physical, physiological, and skill performance variables among volleyball players.

METHODS

The primary objective of this research was to investigate the plyometric training–induced changes in selected physical, physiological, and skill performance variables among volleyball players. The study involved the selection of 40 male intercollegiate volleyball players from Coimbatore, who were randomly assigned to two groups: the Plyometric Training Group (PTG), consisting of 20 participants and the Control Group (CG), consisting of 20 participants. An initial pilot study was conducted to assess the subjects' baseline capacity and to determine appropriate training loads. The PTG participants underwent a structured plyometric training programme three days per week (on alternate days) for a period of twelve weeks, while the CG participants continued their routine activities without any additional training intervention.

DESIGN

The study focused on evaluating four key physical, physiological, and skill performance variables, namely arm explosive power, leg explosive power, breath-holding time, and spiking ability. Arm explosive power and leg explosive power were measured in meters, breath-holding time was measured in seconds, and spiking ability was assessed in points. These variables were selected because they significantly influence the performance of volleyball players during competitive play. All measurements were recorded twice during the experimental period. The first measurement was taken at the pre-test stage before the commencement of the training programme to determine the initial level of the subjects. The second

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measurement was taken at the post-test stage after twelve weeks of plyometric training to evaluate the effectiveness of the training intervention. Standardised testing procedures were followed to ensure the reliability and accuracy of the data collected. The collected data were then analyzed to determine whether plyometric training produced significant improvements in the selected physical, physiological, and skill performance variables among volleyball players.

Training Programme

The training programme consisted of 60-minute sessions conducted three times per week for a period of twelve weeks. Each training session included a 10-minute warm-up, followed by 40 minutes of plyometric training exercises, and concluded with a 10-minute cool-down period. To ensure progressive overload, the intensity of the training workload was gradually increased by 5% every three weeks, progressing from 65% to 75% of the initial workload over the course of the training programme. The prescribed volume of plyometric exercises was determined based on specific sets and repetitions, which were carefully structured to suit the physical capacity of the participants and to maximise training effectiveness while minimising the risk of injury.

Statistical Analysis

The data collected before and after the twelve-week training period for the selected variables influenced by plyometric training were subjected to statistical analysis using the t-test. This analysis was performed to determine whether there were any significant differences between the pre-test and post-test scores. The level of significance was set at a 0.05 level of confidence to assess the effectiveness of the plyometric training programme.

Table 1:Analysis of the t-ratio for the arm explosive power in the experimental group and the control group

Variables	Group	Mean		S.D		t- ratio
		Pre	Post	Pre	Post	
Arm explosive power	Experimental	4.83	4.99	0.09	0.09	16.0*
	Control	4.82	4.82	0.09	0.09	1.30

Significant level 0.05 level

The experimental group improved in arm explosive power, with the mean increasing from 4.83 to 4.99 and a significant *t*-ratio of 16.0 at the 0.05 level. In contrast, the control group showed no improvement (mean 4.82 to 4.82) with a non-significant *t*-ratio of 1.30, indicating the training programme was effective.

Fig 1:Bar diagram showing the mean value on physical variables of arm explosive power of volleyball players in the experimental and control groups

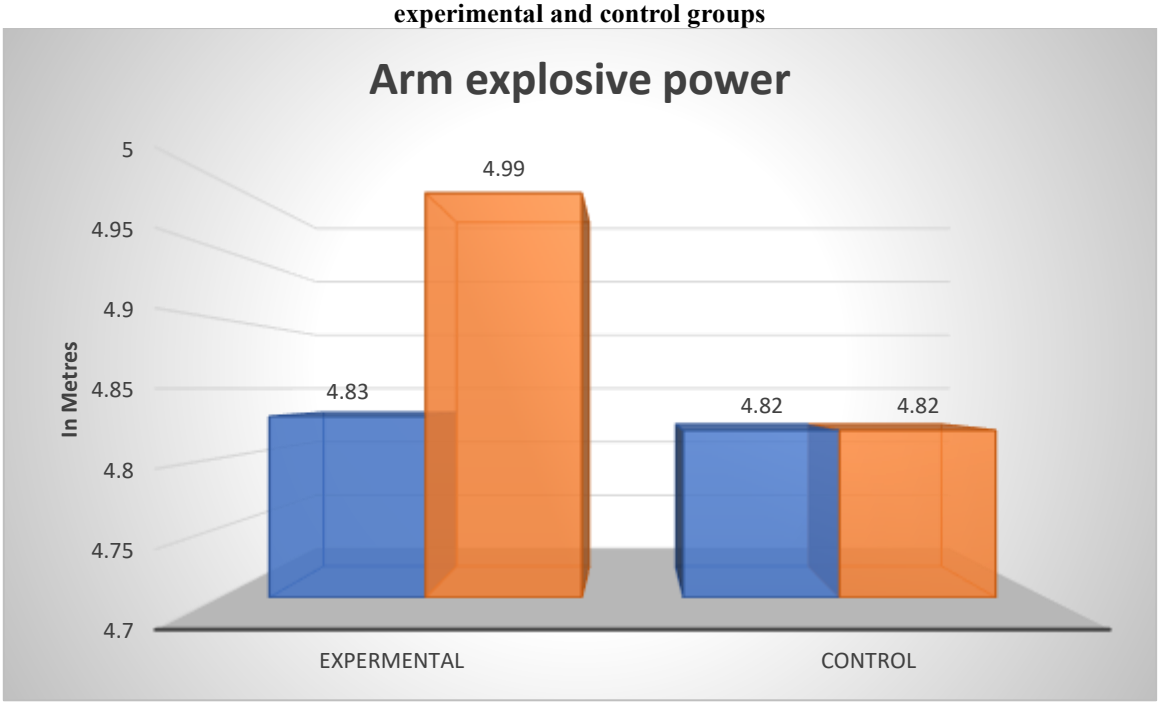


Table 2: Analysis of the t-ratio for the leg explosive power in the Experimental Group and the Control Group

Variables	Group	Mean		S.D		t- ratio
		Pre	Post	Pre	Post	
Leg explosive power	Experimental	1.71	1.89	0.21	0.20	18.0*
	Control	1.71	1.71	0.21	0.21	0.70

Significant level 0.05 level

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The experimental group showed improvement in leg explosive power, with the mean increasing from 1.71 to 1.89 and a significant t-ratio of 18.0 at the 0.05 level. In contrast, the control group showed no change (mean 1.71 to 1.71) with a non-significant t-ratio of 0.70, indicating the training programme was effective.

Fig 2: Bar diagram showing the mean value on physical variables of Leg Explosive Power of volleyball players in the experimental and control groups

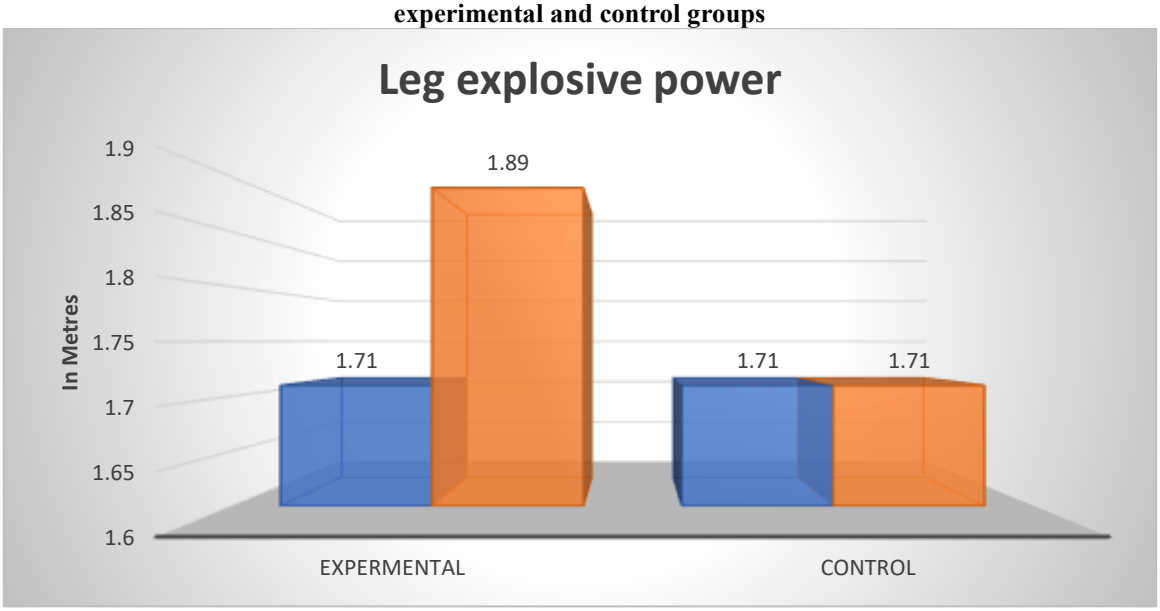


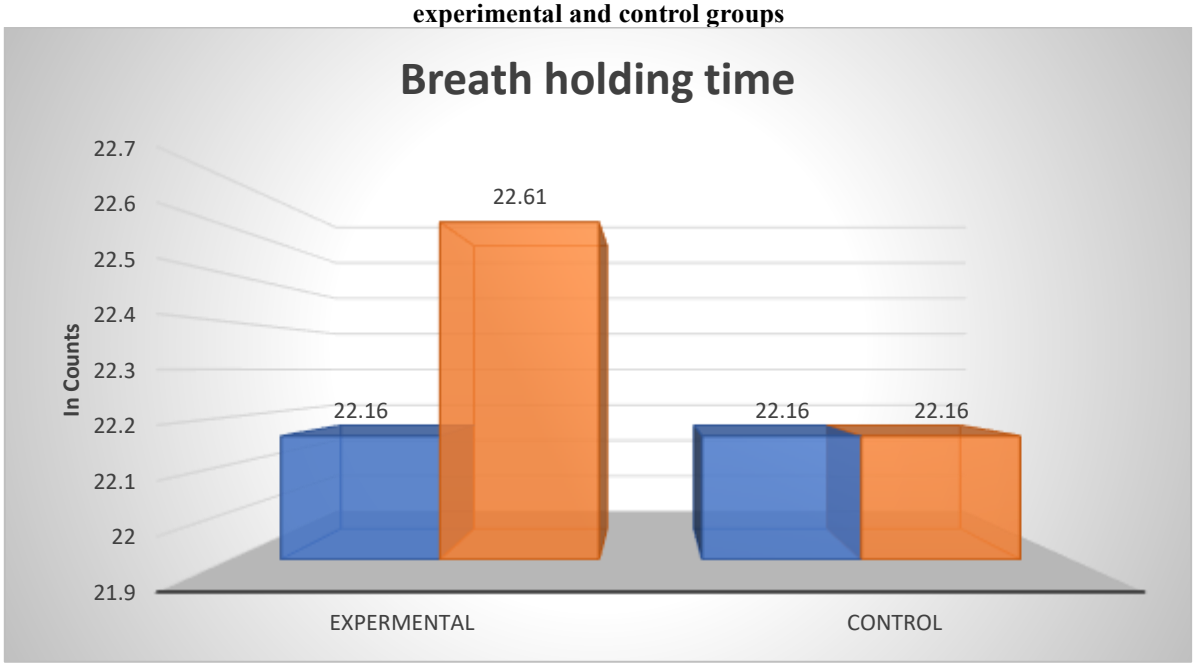
Table 3: Analysis of the t-ratio for the breath-holding time in the experimental group and the control group

Variables	Group	Mean		S.D		t- ratio
		Pre	Post	Pre	Post	
Breath-holding time	Experimental	22.16	22.61	0.46	0.46	30.00*
	Group	22.16	22.16	0.46	0.46	1.00

Significant level 0.05 level

The experimental group showed improvement in breath-holding time, with the mean increasing from 22.16 to 22.61 and a significant *t*-ratio of 30.00 at the 0.05 level. In contrast, the control group showed no change (mean 22.16 to 22.16) with a non-significant *t*-ratio of 1.00, indicating the training programme was effective.

Fig 3: Bar diagram showing the mean value on physiological variables of breath holding time of volleyball players in the experimental and control groups



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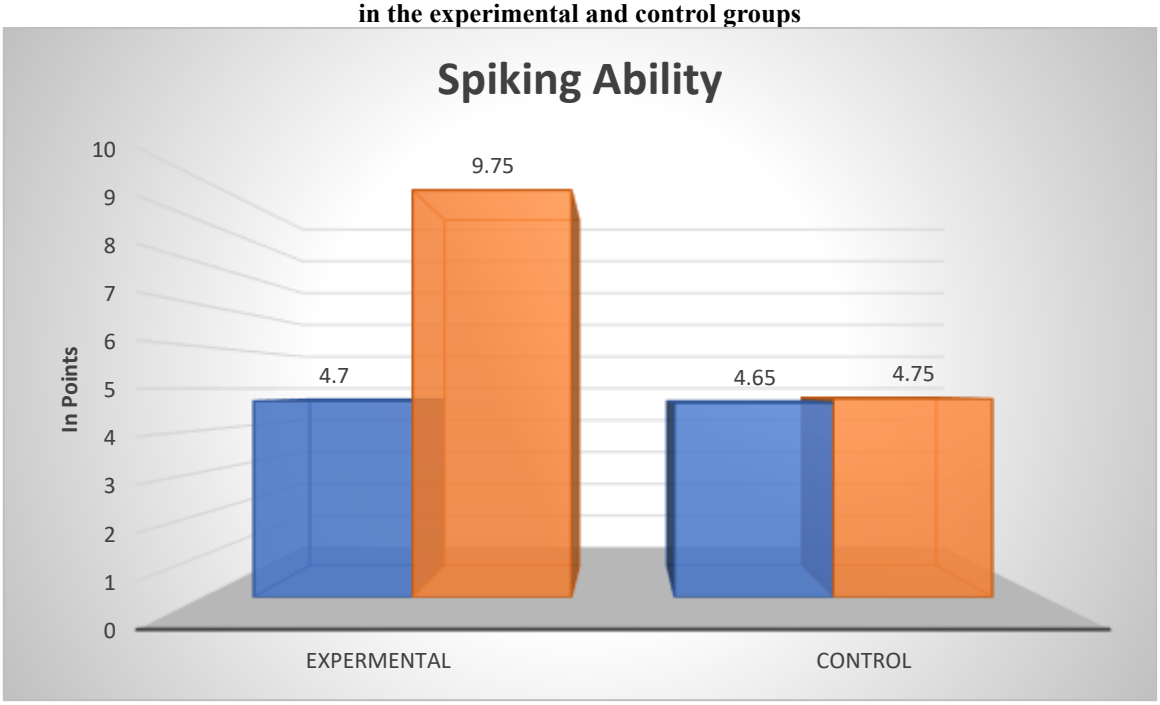
Table 4: Analysis of the t-ratio for the Spiking Ability in the experimental group and the control group

Variables	Group	Mean		S.D		t- ratio
		Pre	Post	Pre	Post	
Spiking Ability	Experimental	4.70	9.75	0.57	0.55	10.00*
	Group	4.65	4.75	0.49	0.55	1.40

Significant level 0.05 level

The experimental group showed significant improvement in spiking ability, with the mean increasing from **4.70 to 9.75** and a *t*-ratio of **10.00**, which is significant at the **0.05 level**. In contrast, the control group showed only a slight change (**4.65 to 4.75**) with a non-significant *t*-ratio of **1.40**.

Fig 4: Bar diagram showing the mean value on skill performance variables of arm explosive power of volleyball players in the experimental and control groups



DISCUSSION AND FINDING

The findings of the present study reveal that the plyometric training programme produced significant improvements in the selected physical, physiological, and skill performance variables among volleyball players. The experimental group showed significant improvement in arm explosive power, leg explosive power, breath-holding time, and spiking ability, while the control group did not show any significant changes during the study period. The significant improvement observed in arm explosive power may be attributed to the explosive nature of plyometric exercises, which enhance neuromuscular coordination and improve the efficiency of the stretch–shortening cycle of the muscles. These exercises stimulate rapid muscle contraction and increase the ability of the muscles to generate force in a short period of time. This finding is supported by Donald A. Chu (1998), who reported that plyometric training significantly enhances muscular power and explosive strength among athletes.

Similarly, the improvement in leg explosive power among the experimental group can be explained by the repeated jumping, bounding, and hopping exercises included in the plyometric training programme. These exercises increase muscle fibre recruitment, particularly fast-twitch muscle fibres, which play a vital role in explosive movements such as jumping and blocking in volleyball. This result is consistent with the views of Tudor O. Bompa (1999), who emphasized that plyometric training is highly effective for developing lower-body power in sports requiring explosive movements. The improvement observed in breath-holding time indicates positive physiological adaptations resulting from the plyometric training programme. Although plyometric training primarily targets muscular power, it also improves respiratory efficiency and oxygen utilization due to the high-intensity nature of the exercises. Regular training stimulates better lung capacity, respiratory muscle strength, and tolerance to oxygen deficit, which ultimately enhances breath-holding ability. This finding is supported by the work of William J. Kraemer and Steven J. Fleck (2004), who reported that structured strength and power training programmes contribute to improvements in physiological parameters such as respiratory efficiency and endurance capacity.

Furthermore, the significant improvement in spiking ability observed in the experimental group may be attributed to the combined enhancement of arm power, leg power, and neuromuscular coordination achieved through plyometric training. Spiking is a complex volleyball skill that requires explosive jumping ability and powerful arm action. The development of these physical qualities through plyometric

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exercises leads to improved technical execution of the spike. This finding is supported by the research conducted by Michael G. Miller et al. (2006), who found that plyometric training improves both physical power and sport-specific skill performance. Overall, the results of the present study clearly demonstrate that plyometric training is an effective method for improving physical power, physiological efficiency, and skill performance among volleyball players. The findings are consistent with previous research in sports science, which emphasizes the importance of explosive power training for enhancing volleyball performance.

CONCLUSION

Based on the findings of the study, it can be concluded that plyometric training has a significant positive effect on selected physical, physiological, and skill performance variables among volleyball players. The results revealed noticeable improvements in arm explosive power, leg explosive power, breath-holding time, and spiking ability in the experimental group after twelve weeks of plyometric training. In contrast, the control group showed no significant changes in these variables. These findings indicate that plyometric exercises are an effective training method for enhancing explosive strength, physiological capacity, and sport-specific skills in volleyball players. Therefore, plyometric training may be incorporated into regular training programmes to improve the overall performance of volleyball athletes.

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