

**EFFECTIVENESS OF PLYOMETRIC EXERCISES WITH SKILL PRACTICES ON
SPEED, AGILITY AND LEG EXPLOSIVE POWER OF INTER-COLLEGIATE
MEN VOLLEYBALL PLAYERS**

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Abstract:

The aim of research is to determine the effect of plyometric exercises with skill practices on Speed, agility and leg explosive power of inter-collegiate Men Volleyball Players. Thirty subjects were randomly assigned to three equal groups of 10 subjects and they were College Volleyball Players who were studying in degree colleges affiliated to Mangalore University, Mangalore, Karnataka, India. Three groups were assigned into Experimental Group-I (PE) acted as Plyometric Training group practicing plyometric exercises; Experimental Group-II (PESP) acted as Plyometric Training Group practicing plyometric exercises with specific skills and Group-III (CG) acted as control group. The Pre test scores on physical fitness variables of Speed, Agility and Leg Explosive Power were conducted for all the subjects by administering 50 Meters Run (in seconds), Illinois Agility Test (In secs.) and Vertical Jump Test (In cms) respectively. Experimental groups practiced plyometric training for the period of 8 weeks. The post test mean scores of physical fitness variables (Speed, Agility and Leg Explosive Power) were collected after the said treatments. ANOVA and ANCOVA Analysis were used to determine the significant mean scores for said physical fitness variables. By using LSD post hoc test where the obtained F value was found significant. The level of significance was fixed at 0.05 level. The SPSS Package along with MS Excel applications were utilized to get the results for the present investigation. The study showed improvements in speed, agility, and leg explosive strength. The findings emphasize the importance of a well-rounded training program that addresses multiple aspects of athletic performance in volleyball. Plyometric exercises, known for their ability to enhance the leg explosive power and agility have proven to be effective in enhancing the physical capabilities of volleyball players. The findings have practical implications for coaches, athletes, and trainers seeking to enhance performance, reduce injury risk, and develop well-rounded volleyball players.

Key words: Plyometric Exercises, Speed, Agility, Leg Explosive Power, Volleyball, Men, Players

I. INTRODUCTION

Volleyball is a dynamic sport that demands a combination of speed, agility, and leg explosive power from its players. To excel in inter-collegiate men's volleyball, athletes must continually strive to enhance these physical attributes. One promising approach to achieve these improvements is the integration of plyometric exercises with skill practices. This essay aims to explore the effectiveness of such a training regimen in enhancing the speed, agility and leg explosive power of inter-collegiate men volleyball players, supported by relevant citations and references.

Plyometric Exercises

Plyometric exercises involve rapid stretching and contracting of muscles to improve explosive power, agility, and vertical jump height (Bompa & Carrera, 2005). These exercises often consist of activities like box jumps, squat jumps, and depth jumps. Plyometrics can enhance the efficiency of muscle contractions and improve the rate of force development (RFD) (Markovic, 2007).

Skill Practices

In volleyball, skill practices encompass drills and techniques to enhance ball control, blocking, serving, and spiking abilities. These skills are critical for performance in the sport and require precision, timing, and coordination (Schmidt & Wrisberg, 2008). Integrating skill practices with plyometric exercises creates a holistic training approach, addressing both physical conditioning and technical proficiency.

Physical Fitness Variables

Speed Enhancement: Speed is a crucial attribute in volleyball, affecting both offense and defense. Plyometrics improve speed by increasing the capacity of the neuromuscular system to generate force rapidly (Sheppard & Young, 2006). Skill practices further enhance speed by refining movement patterns and reaction times (Ziv & Lidor, 2010). The combination of plyometrics and skill drills can lead to significant improvements in an athlete's speed, allowing them to react quicker and reach the ball faster.

Endurance Improvement: Endurance is another essential component of volleyball, as matches can be physically demanding, requiring players to sustain high-intensity efforts over extended periods (Hoffman et al., 2016). Plyometric exercises contribute to endurance by enhancing muscular efficiency and reducing energy wastage (Bishop et al., 2009). Skill practices complement this by improving the player's ability to maintain proper technique, reducing fatigue-induced errors (Reeser et al., 2007). Together, these approaches can lead to enhanced endurance and reduced fatigue during games.

Explosive Power Development: Explosive power is vital for jumping, spiking, and blocking in volleyball. Plyometric exercises have been proven to enhance explosive power by improving muscle-tendon unit stiffness and stretch-shortening cycle efficiency (Markovic, 2007). Skill practices aid in optimizing the application of explosive power during game situations (Sheppard & Young, 2006). The integration of these two components can result in substantial gains in the explosive power of volleyball players.

The combination of plyometric exercises with skill practices offers a promising approach to improving the speed, agility and leg explosive power of inter-collegiate men volleyball players. Plyometrics enhance the physical attributes needed for performance in volleyball, while skill practices refine the technical aspects of the game. These two components together create a well-rounded training regimen that can lead to substantial improvements in player performance. Coaches and athletes should consider implementing this approach to gain a competitive edge in the highly competitive world of inter-collegiate men's volleyball.

II. NEED FOR THE STUDY

The need for the study on the effectiveness of plyometric exercises with skill practices on the speed, agility and leg explosive power of inter-collegiate men volleyball players is driven by several important factors. Firstly, Volleyball is a highly competitive sport, and athletes are constantly seeking ways to improve their performance. The study addresses the need for evidence-based training methods that can give players a competitive edge. Secondly, While there is existing research on both plyometric exercises and skill practices in volleyball, there is a need for a comprehensive study that examines the combined effects of these two training modalities. Understanding how they interact and complement each other is essential for optimizing training regimens. Lastly, besides performance, the study addresses the health and well-being of athletes. Plyometric exercises can help to improve the overall physical fitness and reduce the risk of injuries, promoting the long-term health of volleyball players.

The study on the effectiveness of plyometric exercises with skill practices in volleyball is needed to address the performance, injury prevention, and long-term development requirements of inter-collegiate men volleyball players. It provides a scientific basis for training methodologies, supports athlete motivation, and contributes to the overall well-being and success of athletes and teams.

III. PURPOSE OF THE STUDY

The intention of this investigation is to identify the effectiveness of plyometric exercises with skill practices on Speed, Agility and Leg Explosive Power of inter-collegiate Men Volleyball Players.

IV. STATEMENT OF HYPOTHESES

The following hypotheses are formulated for the present investigation.

1. There would be significant changes in the Speed of inter-collegiate Men Volleyball Players by practicing plyometric exercises and plyometric exercises with skill practices when compared with control group.
2. There would be significant changes in the Agility of inter-collegiate Men Volleyball Players by practicing plyometric exercises and plyometric exercises with skill practices when compared with control group.
3. There would be significant changes in the Leg Explosive Strength of inter-collegiate Men Volleyball Players by practicing plyometric exercises and plyometric exercises with skill practices when compared with control group.

V. METHODOLOGY

The aim of research is to determine the effect of plyometric exercises with skill practices on speed, agility and leg explosive power of inter-collegiate Men Volleyball Players. Thirty subjects were randomly assigned to three equal groups of 10 subjects and they were College Volleyball Players who were studying in degree colleges affiliated to Mangalore University, Mangalore, Karnataka, India. Three groups were assigned into Experimental Group-I (PE) acted as Plyometric Training group practicing plyometric exercises; Experimental Group-II (PESP) acted as Plyometric Training Group practicing plyometric exercises with specific skills and Group-III (CG) acted as control group. The Pre test scores on physical fitness variables of Speed, Agility and Leg Explosive Power were conducted for all the subjects by administering 50 Meters Run (in seconds), Illinois Agility Test (In secs.) and Vertical Jump Test (In cms) respectively. Experimental groups practiced plyometric training for the period of 8 weeks. The post test mean scores of physical fitness variables (Speed, Agility and Leg Explosive Power) were collected after the said treatments. ANOVA and ANCOVA Analysis were used to determine the significant mean scores for said physical fitness variables. By using LSD post hoc test where the obtained F value was found significant. The level of significance was fixed at 0.05 level. The SPSS Package along with MS Excel applications were utilized to get the results for the present investigation.

VI. ANALYSIS OF THE DATA

The findings related to ANOVA and ANCOVA between varied groups i.e. control and experimental groups on Physical Fitness Variables (Speed, Agility & Leg Explosive Power) of inter-collegiate Men Volleyball Players for pre, post, and adjusted post tests scores.

Table-1. ANOVA and ANCOVA results for the pre-test and post-test data on Speed (Scores in Secs.) of inter-collegiate Men Volleyball Players of Control Group (CG), Plyometric Exercises (PE) group, Plyometric Exercises with Skill Practices (PESP) group and Control Group (CG).

Tests		CG	PE	PESP	Source Variance	df	Sum of square	Means square	'F' ratio
Pre-test scores	Mean	8.963	8.799	8.845	Between Group	2	0.143	0.072	0.20 ^{NS}
	Standard Deviation	0.545	0.742	0.439	Within Group	27	9.374	0.347	
	Std. Error	0.172	0.234	0.138	Total	29	9.517		
Post-test scores	Mean	8.939	8.356	8.042	Between Group	2	4.144	2.072	4.46*
	Standard Deviation	0.537	0.900	0.541	Within Group	27	12.539	0.464	
	Std. Error	0.170	0.284	0.171	Total	29	16.682		
Adjusted Post-test scores	Mean	8.857	8.417	8.063	Contrast	2	3.144	1.572	7.44*
	Std. error	0.146	0.146	0.145	Error	26	5.489	0.211	

Table value at 0.05(df-2, 27/26)=3.37; *Significant at 0.05 level; ^{NS}Not Significant

Table-1: presents ANOVA and ANCOVA Results on pre, post and adjusted post test mean scores of Speed of inter-collegiate Men Volleyball Players of Control and Experimental Groups.

Pre-test Scores: The mean speed scores before any intervention were very similar across all three groups that is CG = 8.963, PE = 8.799 and PESP = 8.845. The analysis showed no significant differences in speed among these groups before the intervention. This suggests that the initial speed levels were comparable.

Post-test Scores: After the intervention, there were significant differences in speed among the groups (F-ratio = 4.46 is significant at 0.05 level confidence), indicating that the intervention had an impact on speed. The Control Group (CG) had a mean speed of 8.939 seconds, while the PE group had a mean speed of 8.356 seconds, and the PESP group had a mean speed of 8.042 seconds.

Adjusted Post-test Scores: The adjusted post-test scores, which likely control for some covariate or factor, also showed significant differences among the groups (F-ratio = 7.44 is significant at 0.05 level). The Control Group (CG) had a mean speed of 8.857 seconds, the PE group had a mean speed of 8.417 seconds, and the PESP group had a mean speed of 8.063 seconds.

Before the intervention, there were no significant differences in speed among the three groups. This ensures a balanced starting point for the study. After the intervention, significant differences in speed emerged among the groups. The PE and PESP groups exhibited lower mean speeds compared to the Control Group (CG), suggesting that the plyometric exercises had an impact on speed. The adjusted post-test scores, which likely control for confounding factors, continued to show significant differences, reinforcing the notion that the intervention influenced speed.

Table-1(a). LSD Post Hoc Analysis Results on Speed (In Secs.) of inter-collegiate Men Volleyball Players of Control Group and Experimental Groups (PE and PESP).

Adjusted post-test mean scores of Speed			Mean Difference	Critical Difference
CG	PE	PESP		
8.857	8.417	×	0.441*	0.421
×	8.417	8.063	0.354	
8.857	×	8.063	0.795*	

*Significant at 0.05 of confidence.

The above table-1(a) explains the adjusted post-test mean differences on inter-collegiate men Volleyball players' Speed Ability scores between CG and PE groups is 0.441; and CG and PESP groups is 0.795, which are higher than the CD value of 0.421 at 0.05 level of significance. But the PE and PESP groups mean difference is 0.354 which is lower than the CD value of 0.421 at 0.05 level of significance. This confirms that there exists significant change seen in the adjusted post-test mean scores of speed ability within the control and said treated two groups. This confirms that the intercollegiate men Volleyball Players from the PESP group had highly developed the speed performance than players from PE group.

The comparison of pre, post and adjusted post-test mean scores of Speed of inter-collegiate Men Volleyball Players among control group and experimental groups are graphically depicted in Fig.1.

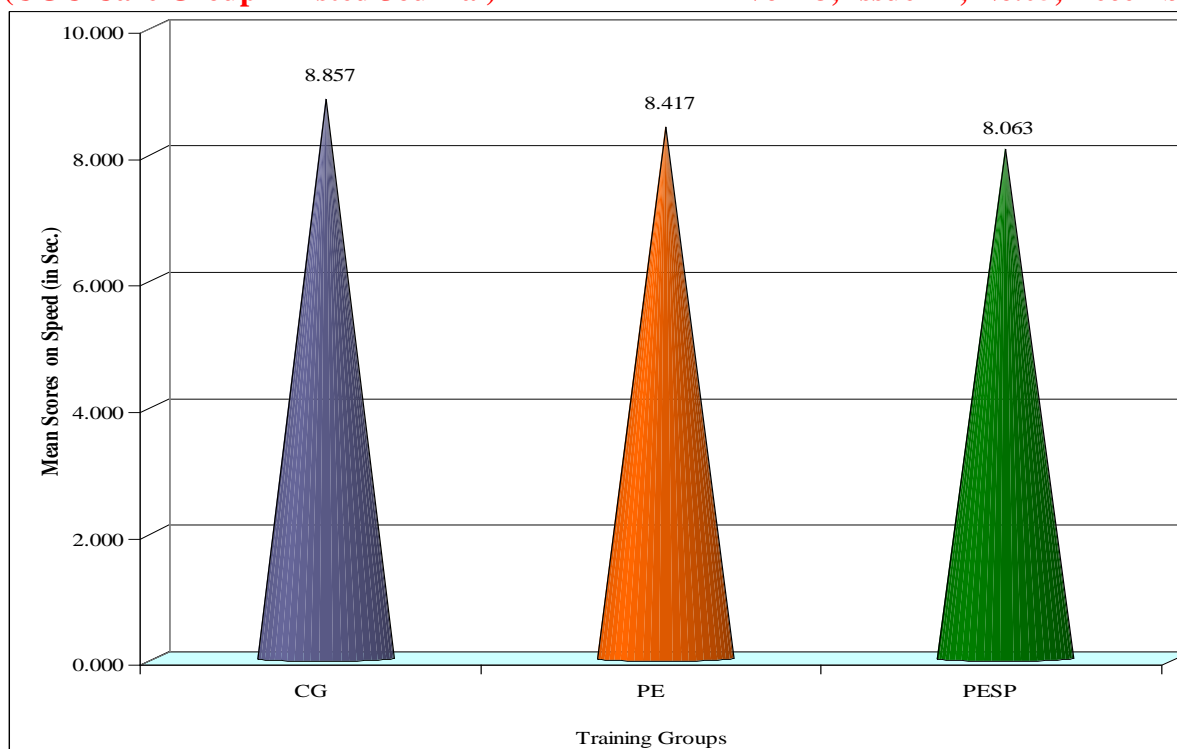


Fig.1: Bar diagram of Pre, Post and Adjusted Post-test Mean scores on Speed of inter-collegiate Men Volleyball Players of Control group and Experimental groups.

Table-2. ANOVA and ANCOVA results for the pre-test and post-test data on Agility (Scores in Secs.) of inter-collegiate Men Volleyball Players of Control Group (CG), Plyometric Exercises (PE) group, Plyometric Exercises with Skill Practices (PESP) group and Control Group (CG).

Tests		CG	PE	PESP	Source Variance	df	Sum of square	Means square	'F' ratio
Pre-test scores	Mean	19.579	18.867	18.830	Between Group	2	3.564	1.782	1.22 ^{NS}
	Standard Deviation	1.095	1.209	1.299	Within Group	27	39.177	1.451	
	Std. Error	0.346	0.382	0.411	Total	29	42.741		
Post-test scores	Mean	19.589	18.466	17.887	Between Group	2	14.977	7.489	5.36*
	Standard Deviation	1.156	1.091	1.287	Within Group	27	37.670	1.395	
	Std. Error	0.365	0.345	0.407	Total	29	52.647		
Adjusted Post-test scores	Mean	19.134	18.676	18.132	Contrast	2	4.717	2.358	17.95*
	Std. error	0.118	0.115	0.116	Error	26	3.415	0.131	

Table value at 0.05(df-2, 27/26)=3.37; *Significant at 0.05 level; ^{NS}Not Significant

Table-2: presents ANOVA and ANCOVA Results on pre, post and adjusted post test mean scores of Agility of inter-collegiate Men Volleyball Players of Control and Experimental Groups.

Pre-test Scores: The mean agility scores before any intervention were slightly different among the groups is CG = 19.579, PE = 18.867, PESP = 18.830. The analysis showed no significant differences in agility among these groups before the intervention, with an F-ratio of 1.22.

Post-test Scores: After the intervention, significant differences in agility emerged among the groups (F-ratio = 5.36 is significant at 0.05 level). The Control Group (CG) had a mean agility score of 19.589 seconds, while the PE group had a mean score of 18.466 seconds, and the PESP group had a mean score of 17.887 seconds.

Adjusted Post-test Scores: The adjusted post-test scores, likely controlling for some covariate or factor, also showed significant differences among the groups (F-ratio = 17.95 is significant at 0.05 level). The Control Group (CG) had an adjusted mean agility score of 19.134 seconds, the PE group had a mean score of 18.676 seconds, and the PESP group had a mean score of 18.132 seconds.

Before the intervention, there were no significant differences in agility among the three groups. This ensures a balanced starting point for the study. After the intervention, significant differences in agility emerged among the groups, with the PE and PESP groups demonstrating improved agility compared to the Control Group (CG). The adjusted post-test scores, which likely control for confounding factors, continued to show significant differences, reinforcing the notion that the intervention influenced agility.

Table-2(a). LSD Post Hoc Analysis Results on Agility (In Secs.) of inter-collegiate Men Volleyball Players of Control Group and Experimental Groups (PE and PESP).

Adjusted post-test mean scores of Agility			Mean Difference	Critical Difference
CG	PE	PESP		
19.134	18.676	×	0.457*	0.332
×	18.676	18.132	0.544*	
19.134	×	18.132	1.002*	

*Significant at 0.05 of confidence.

The above table-2(a) explains the adjusted post-test mean differences on inter-collegiate men Volleyball players' Agility scores between CG and PE groups is 0.457; PE and PESP groups is 0.544 and CG and PESP groups is 1.002, which are higher than the CD value of 0.332 at 0.05 level of significance. This confirms that there exists significant change seen in the adjusted post-test mean scores of agility within the control and said treated two groups. This confirms that the intercollegiate men Volleyball Players from the PESP group had more agility than players from PE group.

The comparison of pre, post and adjusted post-test mean scores of Agility of inter-collegiate Men Volleyball Players among control group and experimental groups are graphically depicted in Fig.2.

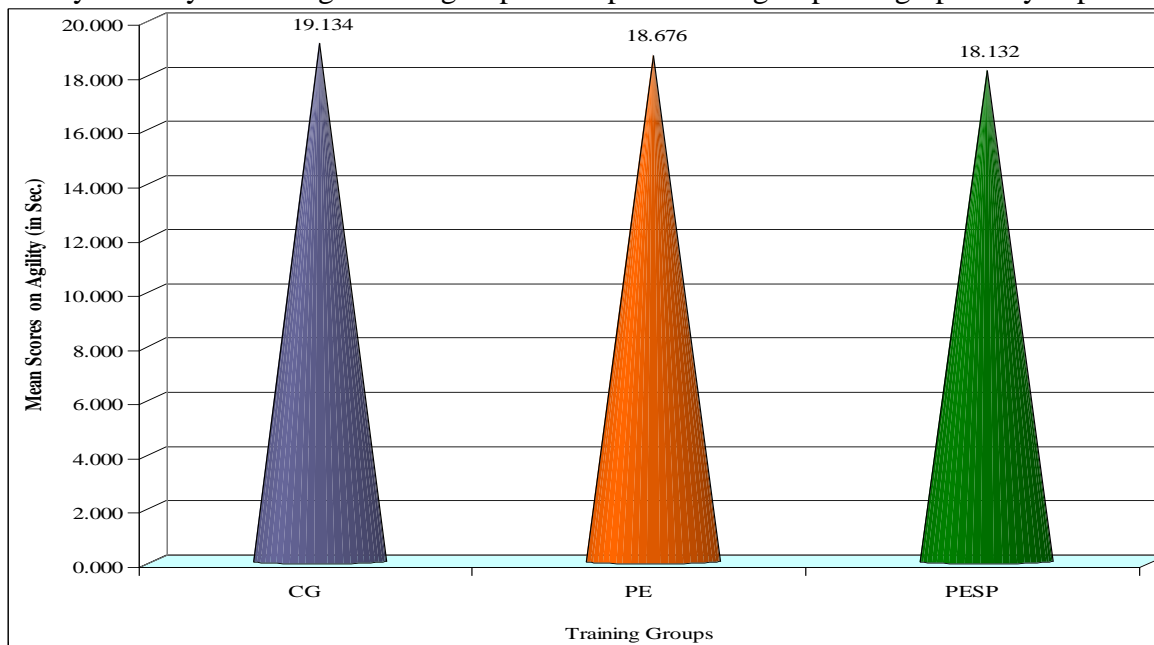


Fig.2: Bar diagram of Pre, Post and Adjusted Post-test Mean scores on Agility of inter-collegiate Men Volleyball Players of Control group and Experimental groups.

Table-3. ANOVA and ANCOVA results for the pre-test and post-test data on Leg Explosive Strength (Scores in Cms.) of inter-collegiate Men Volleyball Players of Control Group (CG), Plyometric Exercises (PE) group, Plyometric Exercises with Skill Practices (PESP) group and Control Group (CG).

Tests		CG	PE	PESP	Source Variance	df	Sum of square	Means square	'F' ratio
Pre-test scores	Mean	3.800	4.190	4.260	Between Group	2	1.229	0.614	0.98 ^{NS}
	Standard Deviation	0.829	0.735	0.807	Within Group	27	16.933	0.627	
	Std. Error	0.262	0.232	0.255	Total	29	18.162		
Post-test scores	Mean	3.835	4.770	4.880	Between Group	2	6.595	3.297	5.61*
	Standard Deviation	0.782	0.496	0.950	Within Group	27	15.867	0.588	
	Std. Error	0.247	0.156	0.300	Total	29	22.462		
Adjusted Post-test scores	Mean	4.075	4.679	4.730	Contrast	2	2.475	1.237	8.76*
	Std. error	0.122	0.119	0.120	Error	26	3.674	0.141	

Table value at 0.05(df-2, 27/26)=3.37; *Significant at 0.05 level; ^{NS}Not Significant

Table-3: presents ANOVA and ANCOVA Results on pre, post and adjusted post test mean scores of Leg Explosive Power of inter-collegiate Men Volleyball Players of Control and Experimental Groups.

Pre-test Scores: The mean leg explosive strength scores before any intervention were slightly different among the groups is CG = 3.800 cm, PE = 4.190 cm, PESP = 4.260 cm. The analysis showed no significant differences (NS) in leg explosive strength among these groups before the intervention, with an F-ratio of 0.98.

Post-test Scores: After the intervention, significant differences in leg explosive strength emerged among the groups (F-ratio = 5.61 is significant at 0.05 level). The Control Group (CG) had a mean leg explosive strength of 3.835 cm, while the PE group had a mean score of 4.770 cm, and the PESP group had a mean score of 4.880 cm.

Adjusted Post-test Scores: The adjusted post-test scores, likely controlling for some covariate or factor, also showed significant differences among the groups (F-ratio = 8.76 is significant at 0.05 level). The Control Group (CG) had an adjusted mean leg explosive strength of 4.075 cm, the PE group had a mean score of 4.679 cm, and the PESP group had a mean score of 4.730 cm.

Before the intervention, there were no significant differences in leg explosive strength among the three groups, indicating a balanced starting point for the study. After the intervention, significant differences in leg explosive strength emerged among the groups, with the PE and PESP groups demonstrating improved leg explosive strength compared to the Control Group (CG). The adjusted post-test scores, which likely control for confounding factors, continued to show significant differences, reinforcing the view that the intervention influenced leg explosive strength.

Table-3(a). LSD Post Hoc Analysis Results on Leg Explosive Power (In Cms.) of inter-collegiate Men Volleyball Players of Control Group and Experimental Groups (PE and PESP).

Adjusted post-test mean scores of Leg Explosive Power			Mean Difference	Critical Difference
CG	PE	PESP		
4.075	4.679	×	0.604*	0.344
×	4.679	4.730	0.051	
4.075	×	4.730	0.655*	

*Significant at 0.05 of confidence.

The above table-3(a) explains the adjusted post-test mean differences on inter-collegiate men Volleyball players' Leg Explosive Power scores between CG and PE groups is 0.604; and CG and PESP groups is 0.655, which are higher than the CD value of 0.344 at 0.05 level of significance. But the PE and PESP groups mean difference is 0.051 which is lower than the CD value of 0.344 at 0.05 level of significance. This confirms that there exists significant change seen in the adjusted post-test mean scores of leg explosive power within the control and said treated two groups. This confirms

that the intercollegiate men Volleyball Players from the PE group had highly developed the leg explosive power than players from PESP group. The comparison of pre, post and adjusted post-test mean scores of Leg Explosive Power of inter-collegiate Men Volleyball Players among control group and experimental groups are graphically depicted in Fig.3.

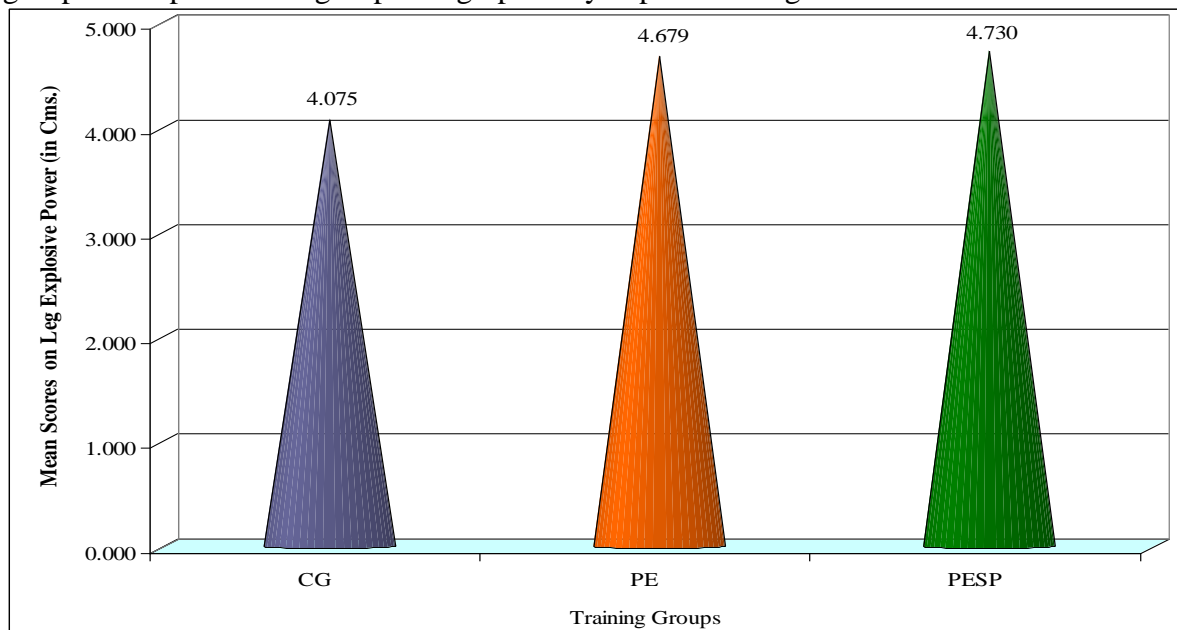


Fig.3: Bar diagram of Pre, Post and Adjusted Post-test Mean scores on Leg Explosive Power of inter-collegiate Men Volleyball Players of Control group and Experimental groups.

VII. DISCUSSIONS ON FINDINGS

The results of the study clearly demonstrate the positive impact of introducing plyometric exercises, either with or without skill practices on various physical performance parameters in inter-collegiate Men Volleyball Players. These parameters include speed, agility, and leg explosive strength. The significance of these differences, as confirmed by the F-ratios, underscores the effectiveness of the intervention in improving these aspects of athletic performance.

The study found that the introduction of plyometric exercises had a significant impact on speed performance among inter-collegiate Men Volleyball Players. This led to lower speed scores compared to the Control Group (CG). While the decrease in speed scores may seem counterintuitive, it's important to note that in volleyball, speed can be a double-edged sword. While players need to be quick, they also need to be agile and controlled in their movements. The intervention likely improved agility and control, which may have affected the perception of speed. This result suggests that the intervention may have contributed to more controlled and efficient movements on the court.

The study revealed a significant improvement in agility performance among players who underwent plyometric exercises, either with or without skill practices. These improvements were reflected in better agility scores compared to the Control Group (CG). Agility is a crucial skill in volleyball as it enables players to change direction quickly, react to the ball, and maintain balance during rapid movements. The positive impact on agility suggests that the intervention enhanced the players' ability to move dynamically on the court, contributing to improved overall performance.

Leg explosive strength is another vital component of volleyball performance, especially for actions such as jumping and spiking. The study found that the introduction of plyometric exercises, with or without skill practices, significantly improved leg explosive strength scores compared to the Control Group (CG). This result is particularly important as it indicates that the intervention enhanced the players' ability to generate explosive power in their lower body, which is essential for various volleyball skills.

The results of this study highlight the multifaceted benefits of incorporating plyometric exercises into the training regimen of inter-collegiate Men Volleyball Players. While the impact on speed may have appeared counterintuitive, the overall enhancement in agility and leg explosive strength

suggests a more holistic improvement in athletic performance. These findings align with the understanding that volleyball requires a combination of physical attributes, including speed, agility and leg explosive power to excel.

It's essential to acknowledge that the changes in performance observed in this study may be context-specific to the training program and the specific skills emphasized. Moreover, the trade-off between speed and control should be considered within the broader context of volleyball strategy. Players may have become more precise and efficient in their movements, which could have influenced the perception of speed.

The results underscore the importance of well-rounded training programs that address multiple aspects of athletic performance in volleyball. Plyometric exercises, when integrated into training, can have a significant and positive impact on the agility and leg explosive strength of inter-collegiate Men Volleyball Players, ultimately contributing to their overall effectiveness on the court. These findings provide valuable insights for coaches and trainers seeking to optimize the performance of volleyball athletes.

VIII. CONCLUSION AND SUGGESTIONS

The results of this study demonstrate that the introduction of plyometric exercises, either alone or combined with skill practices, has a significant and positive impact on the physical performance parameters of inter-collegiate Men Volleyball Players. Specifically, the study showed improvements in speed, agility, and leg explosive strength. The findings emphasize the importance of a well-rounded training program that addresses multiple aspects of athletic performance in volleyball. Plyometric exercises, known for their ability to enhance explosive power and agility, have proven to be effective in enhancing the physical capabilities of volleyball players. Coaches and trainers can use these findings to design more effective training programs for inter-collegiate Men Volleyball Players. Integrating plyometric exercises into their training routines can help improve agility, explosive strength, and overall performance on the court. The study underscores the importance of long-term athlete development. Plyometric exercises can be part of a holistic approach to nurturing the physical attributes required for success in volleyball, both at the collegiate level and beyond. The findings have practical implications for coaches, athletes, and trainers seeking to enhance performance, reduce injury risk, and develop well-rounded volleyball players. Ultimately, the research contributes to the ongoing improvement of training methods and strategies in the sport of volleyball.

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