



Influence of Structured Plyometric and Mobility Training Programs on Speed and Flexibility Adaptations in Collegiate Male Basketball Players

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Abstract:

Background: Speed and flexibility are essential physical components that influence performance in basketball. Training methods such as plyometric training and mobility exercises are widely used to enhance these components. However, the comparative effectiveness of these training methods on collegiate basketball players requires further investigation.

Methods: In this study, 45 male basketball players from JAIN University, aged 18 to 25, were randomly assigned to three groups of fifteen: the mobility exercise group (MEG), the control group (CG), and the plyometric training group (PTG). Over eight weeks, the experimental groups followed their respective training programs, while the control group received no special instruction. Flexibility was tested using the sit-and-reach method, and speed was measured with a 50-meter run. Data was analyzed using Scheffé's post-hoc test and ANCOVA at a 0.05 significance level.

Result: The experimental group outshined the control group, showing clear improvements in both speed and flexibility. While both training techniques greatly increased flexibility, the mobility exercise group showed more speed improvement than the plyometric group. At the 0.05 significance level, the F-ratios for both the post-test and the adjusted post-test scores were found to be statistically significant.

Conclusion: Plyometric training and mobility exercises are effective in improving speed and flexibility among collegiate male basketball players. Mobility exercises showed a comparatively greater effect on speed, while both training methods significantly improved flexibility, making them valuable components in basketball training programs.

Keywords: Basketball Players, Flexibility, Mobility Exercise, Plyometric Training, Speed

1. INTRODUCTION

Plyometric workouts, derived from the term Plyo meaning more and metric referring to a measured amount, are founded on the principle that quickly stretching a muscle before it contracts can lead to a significantly stronger contraction (Jadiya et al., 2025, Canli, 2024). These exercises rely on dynamic assessments that utilize gravitational pull and the capability and flexibility of muscle fibers to enhance the tension placed on specific muscles

(Yu et al., 2025). Plyometric conditioning can be considered as a progression of the 'shock' technique designed to enhance muscle strength for athletic performance, as suggested by Verkhoshonkia, a Russian coach for the jumping events in 1966 (Deng et al., 2024).

Mobility, especially in the hips and ankles, is essential for avoiding injuries and moving effectively throughout the season (Behm et al., 2017, Noufal et al., 2025). Each time an athlete sprints or jumps, activities frequently performed in basketball, they participate in "triple extension," signifying the stretching of their ankles, knees, and hips (Lorás et al., 2020). If any of these three joints is restricted in its movement, the athlete may not achieve their maximum running speed or jumping height (Gäbler et al., 2018). Furthermore, when a player lands after running or jumping, it is crucial for the force of impact to spread through those same three joints (Marzouki et al., 2022). If any of those joints cannot bend adequately to absorb the shock, it places significant strain on the nearest

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joint (Oliver et al., 2024). For example, when a participant has rigid or unyielding ankles or hips, it not only restricts their capacity to sprint and leap but also adds extra strain on their knees (Prietogonz & Sedlacek, 2022). A variety of straightforward exercises exist that can enhance ankle mobility while also strengthening them to prevent injuries (Liu & Si, 2024). To improve your performance and avoid injuries like sprains, fractures, and strains, incorporate these exercises into your routine training sessions and practices (Kanaujia et al., 2023).

2. MATERIAL AND METHOD

The aim of the study was to explore how plyometric workouts and flexibility exercises impact specific physical traits in male basketball players. For this investigation, 45 players from

JAIN University were selected. They ranged in age from eighteen to twenty-five. Three separate groups, each with fifteen participants, were randomly selected from among the players. The first group participated in plyometric training, the second group practiced mobility exercises, while the third group acted as the control. Groups one and two completed their assigned workout plans over a span of twelve weeks, whereas the control group received no training at all. (Lorenzo-calvo, 2021). An analysis of ANCOVA (standard versus covariance) approach was used to examine the three groups. Scheffe's test was used to determine whether particular groups had significant differences if there was a noticeable variation in the average findings across the groups (Bhunja & Ray, 2024).

Table 1. Independent and Dependent Variables

A Separate Variable	Dependent Factor
Plyometric Activities	Speed
Mobility Training	The Leg's Explosive Power

The dependent as well as independent variables used in this investigation are shown in Table 1. Plyometric training and mobility training, which were used as therapy treatments, are examples of independent variables. In the meanwhile, the dependent variables, which were assessed to

ascertain the impact of the training regimens, are leg explosive power and speed. This classification of variables provides a clear framework for analyzing how different training methods influence specific physical performance components among basketball players (Wang et al., 2023).

Table 2. Measurement of Speed and Flexibility Variables

No	Variables	Test objects	Units
1	Speed	50-Meter Run	Seconds
2	Adaptability	Sit and Reach	Centimeters

The measuring tools used to evaluate the dependent variables in this study are listed in Table 2. The 50-meter run test checked speed, with times recorded in seconds, while the sit-and-reach test gauged flexibility, with results measured in centimeters. These standardized tests are widely recognized in sports science research and provide reliable data

for evaluating physical performance. The use of appropriate test items ensures the validity and accuracy of the data collected in analyzing the effects of plyometric and mobility training (Belli et al., 2022).

3. RESULT AND DISCUSSION

Table 3. Covariance analysis for the Pre, Post, and Adjusted Post Tests

Test	PTG	MEG	CG	Sum of Variance	Sum of Squares	Df	Mean Squares	F ratio
Pre-Test Average	7.54	7.65	7.87	BG	0.81	2	0.40	1.35
				WG	12.58	42	0.30	
Post-Test Average	6.82	6.68	7.58	BG	7.04	2	3.52	20.18*
				WG	7.32	42	0.17	
Modified Post-Test Average	6.84	6.69	7.55	BG	6.03	2	3.01	17.82*
				WG	6.93	41	0.16	

Starting average speeds were 7.54 for the mobility exercise group, 7.65 for the plyometric training

group, and 7.87 for the control group. Speed had an observed 'F' value of 1.35 during the pre-test. At a





0.05 confidence level, this number falls short of the critical threshold of 3.22 established for 2 and 42 degrees of freedom. After the post-test, the control group, mobility exercise group, and plyometric training group recorded average speeds of 7.58, 6.68, and 6.82, respectively. The speed F-value came in at 20.18, which, at the 0.05 confidence level, was well above the cutoff of 3.22 for 2 and 42 degrees of freedom. Following the post-test, the

control group, mobility exercise group, and plyometric training group had adjusted average speeds of 7.55, 6.69, and 6.84, respectively. The corrected post-test speed has a 'F' value of 17.82. This exceeded the critical value of 3.23 for 2 and 41 degrees of freedom at the 0.05 confidence level, with both the plyometric and mobility training groups showing clear speed improvements the control group (Li & Li, 2024).

Table 4. The Scheffe's Test

PTG	Means		Mean Difference	Required CI
	MEG	CG		
6.84	----	7.55	0.71*	0.47
----	6.69	7.55	0.80*	0.47
6.84	6.69	----	0.15	0.47

The revised average results were 0.71 for the control group, 0.80 for the mobility exercise group, and 0.15 for the plyometric training group. A value of 0.47 was needed for the confidence range. The mobility exercise group performed better than both

the plyometric training group and the control group, as the average differences in speed between the test groups and the control group exceeded the specified critical range value (Nuetzel, 2023).

Figure 1. Mean values of the before, post, and adjusted post tests

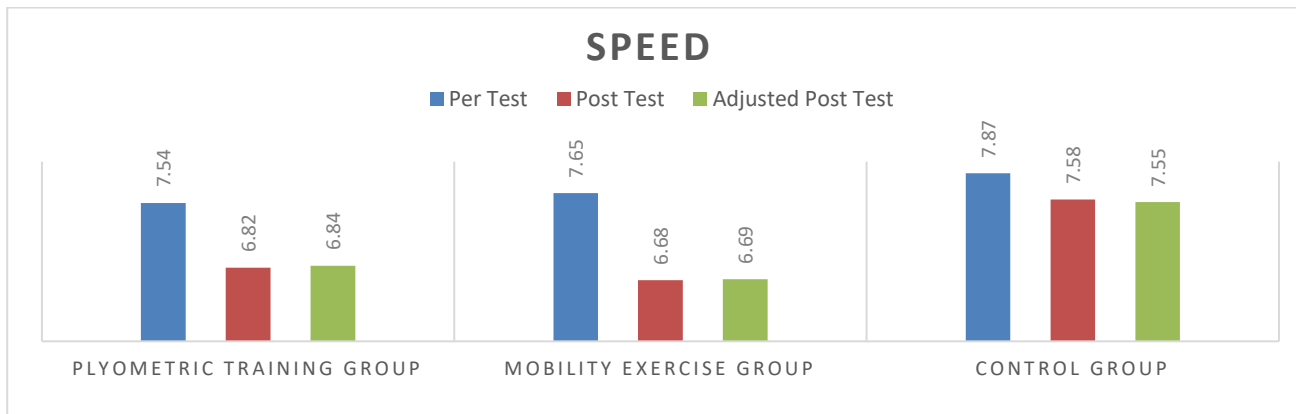


Figure 1 presents the pre-test, post-test, and adjusted post-test average speeds for the plyometric training, mobility exercise, and control groups. Both experimental groups performed better than the control group, with the mobility exercise group edging out the plyometric group in both post-

test and adjusted post-test results. The control group showed little to no progress. These results indicate that both plyometric and mobility training programs are effective in enhancing speed, with mobility training yielding comparatively greater improvement (Chandra et al., 2023).

Table 5. Examination of Variance

Test	PTG	MEG	CG	Source of Variance	Sum of Squares	Df	Mean Squares	F ratio
Pre Test Mean	21.53	22.46	21.06	BG	15.24	2	7.26	1.66
				WG	192.40	42	4.58	
Post Test Mean	29.93	27.93	20.73	BG	619.20	2	309.60	63.86*
				WG	203.60	42	4.84	
Adjusted Post Test Mean	29.27	27.27	21.27	BG	505.46	2	252.73	185.90*
				WG	55.73	41	1.35	

At the beginning, the average flexibility scores were 21.53 for the plyometric training group, 22.46

for the mobility exercise group, and 21.06 for the control group. The pre-test flexibility F-score came

in at 1.66, below the needed 3.23 for 2 degrees of freedom at the .05 confidence level, showing there wasn't much difference between the groups before training (Burtscher et al., 2018). After the post-test, the average scores rose to 29.93 for plyometric training, 27.93 for mobility exercises, and 20.73 for the control group. The post-test F-score jumped to 63.86, well above the critical value of 3.23, showing significant improvements in the experimental groups' flexibility compared to the control group (Vaithianathan et al., 2020).

After the test, the groups that concentrated on plyometric training, mobility exercises, and the control group had adjusted average flexibility scores of 29.27, 27.27, and 21.27, respectively. At a 0.05 significance level, the modified post-test on flexibility yielded an F statistic of 185.90, well above the critical value of 3.23 for 2 and 41 degrees of freedom. This result indicates a strong level of significance in the adjusted average flexibility scores among the plyometric training cohort, mobility exercise cohort, and control cohort, as the F statistic exceeded the required threshold (Hughes et al., 2018).

Table 6. The Scheffe's Test

PTG	Average		Average Difference	Required CI
	MEG	CG		
29.27	-	21.27	7.99	2.07
-	27.27	21.27	5.99	2.07
29.27	27.27	-	2.01	2.07

The information shown in table 6 shows a clear difference in the adjusted averages after the test about flexibility among the group that did plyometric training, the group that did mobility exercises, and the control group. The average differences were 2.01 between the mobility

exercise group and the plyometric training group, 7.99 between the mobility exercise group and the control group, and 5.99 between the plyometric training group and the control group. The required confidence interval was 2.07 (Atakan & Li, 2021).

Figure 2. Cylinder Diagram Illustrating the Average Values of Flexibility

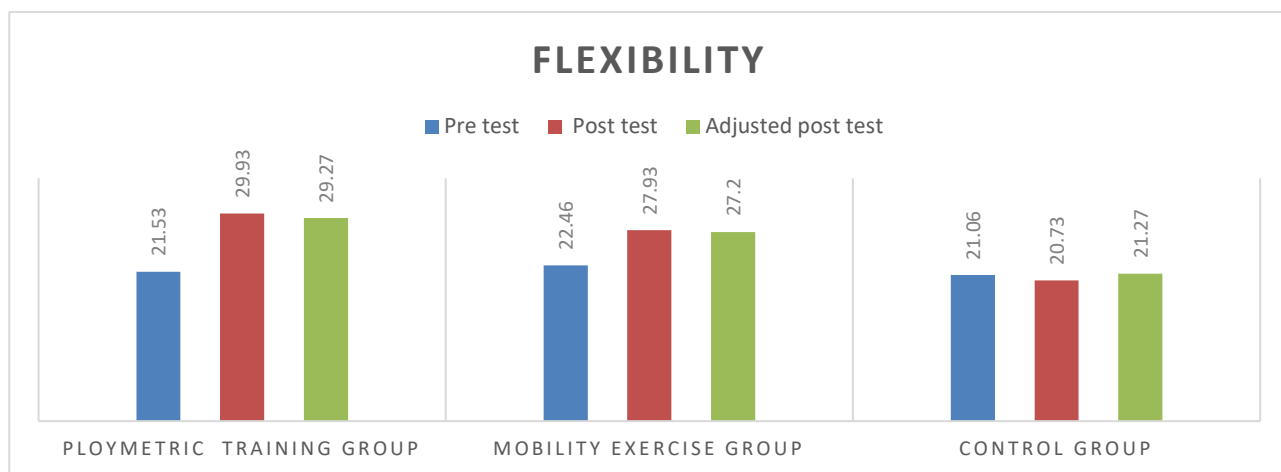


Figure 2 presents the comparison of flexibility scores among the three groups based on pre-test, post-test, and adjusted post-test mean values. The results indicate a substantial improvement in flexibility for both the plyometric training group and the mobility exercise group when compared to the control group. The plyometric training group demonstrated slightly higher flexibility gains than the mobility exercise group in the adjusted post-test scores. Meanwhile, the control group showed little to no improvement. These findings confirm that both training methods significantly enhance

flexibility, with plyometric training showing a marginally greater effect (Keoliya et al., 2024).

4. CONCLUSION

According to the study's findings, collegiate male basketball players' speed and flexibility are greatly increased by both plyometric training and mobility exercises. The effectiveness of organised training interventions was proved by the experimental groups' higher improvements as compared to the control group. Specifically, mobility exercises showed a relatively greater effect on improving speed, while both training methods contributed



substantially to enhancing flexibility. These results show how crucial it is to include both plyometric and mobility training in basketball conditioning programs to optimize physical performance and support overall athletic development.

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6. AUTHOR CONTRIBUTION STATEMENT

A.P. contributed to the conceptualization of the study, research design, supervision of the training program, and final review of the manuscript. M.P.R. contributed to data collection, implementation of the training protocol, and initial manuscript preparation. G.D. helped with paper editing, data analysis, and result interpretation. The final draft of the work was reviewed and approved by all authors.

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