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Unlocking Explosive Power: Investigating The Impact Of Complex Training On University Men's Basketball Players

S Aravindhan[1], Dr Y C Louis Raj[2]
[1,2]Department of Physical Education and Sports Sciences, Faculty of Science and Humanities, SRM Institute of Science and Technology, Kattankulathur – 603203, Tamil Nadu, India

Abstract
The study aimed to investigate how plyometric, strength, and complex training impact the explosive power of university male basketball players, both individually and in combination. For the research, sixty basketball players between the ages of 18 and 25 were elected at random from colleges affiliated with SRMIST in Chennai, Tamil Nadu, India. These participants were divided into four groups, each comprising 15 players. Group 1 underwent plyometric training, Group II received strength training, Group III engaged in complex training, while Group IV served as the control group. Pre–test scores were collected before the 12-week experimental period commenced. In order to evaluate speed, post-test scores have been recorded subsequent to the intervention. Analysis of Covariance (ANCOVA) was utilized to examine mean differences between retest and post-test scores as part of the statistical analysis. Significant findings were further analyzed using Scheff's post hoc test, with a confidence level of 0.05 for hypothesis testing. Results indicated that the combined training group showed superior performance and explosive power among university men basket ball players compared to the other groups.
Keywords: Plyometric, strength, complex, explosive power, isolated, Basketball.

I.INTRODUCTION

The author of this study looked closely at how eccentric resistance training affected a number of physical performance measures in players aged 18 and under. These included muscular strength, vertical leap height, sprinting speed and agility [1]. To compile the requisite data, the author systematically scoured original journal publications from as early as 1950 up to June 2022, utilizing electronic databases such as PubMed, SPORT Discus, and Google Scholar's advanced search feature. The study looked at a lot of comprehensive journal papers to find out what effects idiosyncratic resistance training has on adolescent athlete's physical ability in the short and long run. Youth athletes were characterized as individuals aged 18 or younger participating in sports. A modified version of the Downs and Black assessment was utilized in order to assess the methodological competence and bias of every research prior to the extraction of data. This was done in order to ensure the reliability of the data. Initially, 749 studies were identified, of which 436 were reproductions. Following a review of titles and abstracts, 300 studies were excluded, and an additional 5 studies were eliminated after applying the improvedDowns and Black specification. Subsequently, 14 more revisions were uncovered during backward screening. Consequently, our systematic review encompassed a total of 22 studies. For young players, the Nordic hamstring workout and flywheel motion therapy were the two most popular ways to do idiosyncratic resistance training. It was found that improvements in athletic ability were more closely linked to increasing the cutoff angle that to the number of sets and repetitions done during the Nordic leg exercise. One could make these improvements even better by adding high-speed running or workouts that stretch hips. Conversely, flywheel inertial training necessitates a minimum of three familiarization trails to induce significant adaptations.

Furthermore, it is imperative to emphasize the significance of concentrating on slowing down the spinning flywheel precisely in the last one to two thirds portion of the eccentric phase, rather than progressively during the entire eccentric phase. The systematic review's conclusions support the inclusion of eccentric resistance training in young athlete's training regimens to improve their muscular strength, vertical leap, sprinting, and agility. Currently, flywheel inertial training and the Nordic hamstring exercise are the two main eccentric resistance training techniques. However, as noted by Bright et al. in 2023, the possibility of intensified eccentric loading in enhancing jump performance merits more investigation in subsequent studies.

Plyometrics encompasses exercises designed to enhance muscle strength rapidly within a short duration. This rapid strength generation is commonly referred to as power. A fundamental criterion for an exercise to qualify as plyometric is its inclusion of an eccentric phase, which activates proprioceptors sensitive to swift stretch and loads sequential elastic components like tendons and cross-links between fibers, facilitating a rebound effect. Maintaining adequate flexibility is vital when initiating a plyometric training regimen. Plyometric training has emerged as a pivotal component in the training regimes of athletes engaged in activities such as jumping, lifting, or throwing [2] [3].

The significance of developing power in sports is paramount, prompting strength and conditioning experts to dedicate considerable time to researching effective methods. Recent studies indicate that integrating plyometric and resistance training exercises into regimens can boost vertical jump height, explosive power, and sprint speed. This improvement is attributed to the enhancement of peak muscle power and power production, as proposed by Chu in 1998 [1]. Physical fitness constitutes a fundamental component of an individual's overall well-being, encompassing social, emotional, and mental dimensions. It stands as a cornerstone for maintaining a healthy lifestyle, enabling individuals to execute daily tasks without experiencing fatigue. Whether engaging in slow or fast movements, both strength and endurance play pivotal roles across all sporting activities. Furthermore, agility represents a fusion of various athletic attributes, including power, co-ordination, reaction time, speed of movement, and strength, all essential for peak performance. Demonstrating agility proves indispensable in executing maneuvers such as dodging, zigzag running, rapid changes in direction, and swift adjustments of body positions [4].

The plyometric training regimen is divided into five phases. Initially, in Stage 1, participants engage in simple jumps on level ground, limiting themselves to 60 responses. They vary the types of jumps used andcommit to training twice weekly for four weeks. Moving to Stage 2, the intensity increases as the total responses rise to 80, and an additional day is dedicated to plyometric exercises, focusing on bounding jump boxes of varying heights. Stage 3 sees a further increase in responses to 100, incorporating more challenging sequences such as uphill or stair-bound jumps, alongside single response and depth jumps, while also extending the distance for sequential bounding exercises. Stage 4 involves a gradual escalation in intensity, with participants aiming for 120-150 responses per session, utilizing deeper depth jumps and introducing a slight incline. Finally, Stage V targets elite athletes, maintaining response numbers but intensifying the speed and distance of exercises, with an increase focus on hurdle jumps set at greater height and distances apart.

The purpose of the study was to investigate how sophisticated training affected different physical fitness metrics in football players. Thirty male football players, ages 10 to 25, who were enrolled at Kongu Arts and Science College in Erode District, Tamil Nadu, were chosen as volunteers in order to accomplish this goal. These participants were split into two groups evenly: the complex training group and the control group [5]. Following a protocol outlined by Nandakumar and Ramesh in 2020, the complex training group engaged in three sets/exercise /session, ranging from 60% to 80% intensity, with incremental load adjustments over several weeks. Strength endurance was evaluated using sit-ups, while agility was assessed through shuttle runs. The data were analyzed using ANCOVA. The findings indicated a statistically significant discrepancy in agility and strength endurance between the control group and the complex training group.

II.METHODOLOGY

The primary goal of this research is to investigate the individual and combined impacts of plyometric, strength, and complex training on the explosive power of basket ball players [6] [7]. To achieve this objective, 64 players were randomly recruited as participants from different institutions affiliated with SRM Institute of Science and Technology, located in Chennai, Tamil Nadu, India. The age range of the selected players falls between 18 and 25 years. The players were split into four groups equally, each comprising fifteen participants. Group I received plyometric training, Group II experienced strength training, and Group III participated in complex training, while the fourth group served as the control. Initial pre-test scores of the subjects were recorded, and the experimental period lasted twelve weeks. Following the intervention, the subject's explosive power was assessed through post-test scores.

ANCOVA was utilized to identify significant mean differences between pre and post-test performance [8]. ANCOVA, short for Analysis of Covariance, stands as a pivotal statistical tool employed to discern whether noteworthy disparities exist in the average scores observed between pre-test and post-test measurements within a study's framework. It operates by scrutinizing the means of different groups while simultaneously factoring in additional variables, referred to as covariates., which have the potential to exert influence on the outcome being studied. Essentially, the pre-test performance serves a dual role within this analytical framework: not only does it provide an initial baseline measure, but it also assumes the role of a covariate, aiding in the control of any initial discrepancies that might exist between the groups under examination. By harnessing the power of ANCOVA, researchers are able to effectively gauge the significance of shifts in post-test performance, all the while adjusting for any variations that may have been present in the pre-test scores [9]. This analytical approach proves indispensable in the realm of evaluating the efficacy of interventions or treatments, as it facilitates a comprehensive assessment of meaningful alterations in the outcome variable both before and after the implementation of said intervention or treatment. Scheff's post hoc test was employed to further examine significant findings, with a fixed confidence level of 0.05 for hypothesis testing in all cases [10].

III.RESULTS

Table 1 provides a visual representation of the predetermined means for each of the groups involved in the study, Specifically, it outlines the pre-test means for the plyometric, strength, complex training, and control groups, which were calculated as 35.48, 35.70, 36.28, and 35.16 respectively. Additionally, F-ratios of 1.352 and 2.76 were computed for the pre-test and post-test phases respectively. It's important to note that the pre-test mean F-ratio was determined to be statistically insignificant at a confidence level of 0,005 for 3 and 56 degrees of freedom. Based on this result, it looks like there weren't significant variations among the experimental and control groups before any changes were implemented. In essence, this indicates that the randomization process effectively distributed participants across the groups in a manner that minimized any discernible discrepancies between them.

Table 1. Mathematical analysis of covariance for all the four groups (in Centimetres)

Test Mean	PTG	STG	CTG	CG	SoV	SS	dF	MS	FR
Pre-Level	35.48	35.7	36.28	35.16	BG	10.044	3	3.348	1.352
					WG	138.665	56	2.476	
Post Level	38.58	38.18	41.36	35.39	BG	267.751	3	89.25	37.095*
					WG	134.735	56	2.406	
Adjusted Post Level	38.56	38.19	41.42	35.34	BG	261.238	3	87.079	35.968*
					WG	133.156	55	2.421	

PTG	Plyometric Training Group	STG	Strength Training Group	CTG	Complex Training Group
CG	Control Group	BG	Between Group	MS	Mean Squares
SoV	Source of Variance	SS	Sum of Squares	FR	F-Ratio
dF	Degree of Freedom (Table Values for the 0.05 Level for dF 3 and 55 = 2.77)	WG	Within Group (Table Values for the 0.05 Level for dF 3 and 56 = 2.76)		

Table 2. Explosive Power Scheffe's Test for variations in Adjusted Post-Test Means

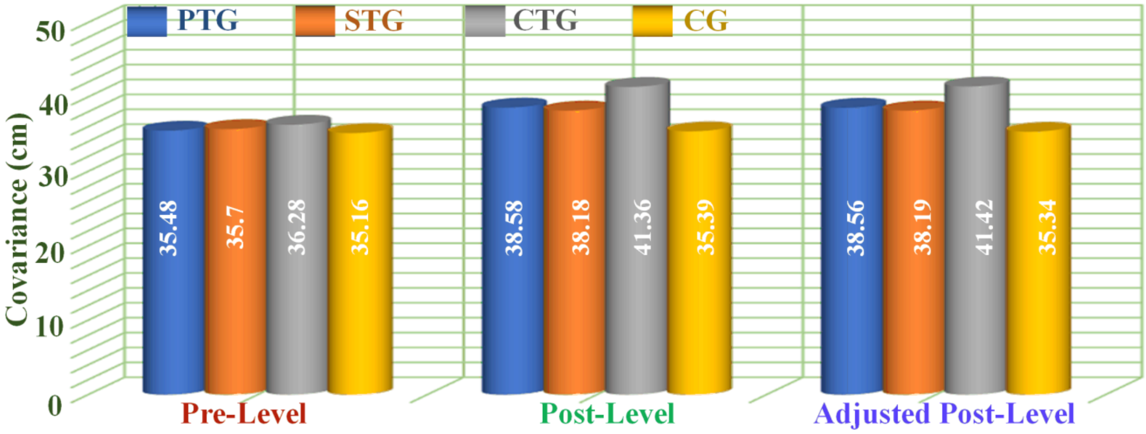
Adjusted Post-Test Means				**Mean Difference**	**Confidence Interval**
PTG	STG	CTG	CG		
38.56	38.19	--	--	0.37	
38.56	--	41.42	--	2.86*	
38.56	--	--	35.34	3.22*	1.63
--	38.19	41.42	--	3.23*	
--	38.19	--	35.34	2.85*	
--	--	41.42	35.34	6.09*	

*Substantial at 0.05 level of assurance

The post-test means for the plyometric training, circuit training, combined training, and control groups were 38.58, 38.18, 41.36. and 35.39 respectively. These resulted in F-ratios of 37.095 and 2.76 for the obtained and table G-ratios. Notably, the mean F-ratio for the post-test was statistically significant at a confidence level of 0.05, with degrees of freedom of 3 and 56, indicating substantial differences among the post-test means. Adjusting for these differences, the attuned post-test means were 38.56, 38.19, 41.42, and 35.34 for the plyometric training, circuit training, combined training, and control groups respectively. The corresponding attuned F-ratios were 35.968 and 2.77, which remained statistically significant at the 0.05 confidence level, with degrees of freedom of 2 and 55. These findings underscore the significant impact of experimental training on explosive strength, highlighting notable differences among the means.

Table 2 indicates significant disparities in the adjusted means between the PTG and combined group (2.86), PTG and CG (3.22), circuit training and combined group (3.23), circuit training and CG (2.85), and combined group and CG (6.09). With a confidence level of 0.05 and a confidence interval value of 1.63, there were no notable differences observed between the PTG and circuit training groups (0.37).

Figure 1.Differences in Explosive Power Pre-Post and Adjusted Post-Test among PTG, STG, CTG, and CG



The findings of our study underscore the profound impact of structured training protocols on the physical, physiological, and performance dimensions crucial to the athletic prowess of university-level basketball players [6]. Over a rigorous twelve-week regimen, both strength training and plyometric training emerged as potent catalysts for transformative improvements across the selected variables. Notably, the robust gains observed in these domains affirm the efficacy of targeted training modalities in eliciting tangible enhancements in the multifaceted skill set required for competitive basketball play. Moreover, the amalgamation of these training modalities within the combined training group yielded unparalleled results, showcasing a synergistic effect that propelled athletes to surpass their counterparts in key performance metrics. These findings not only validate the strategic integration of diverse training methodologies but also emphasize the pivotal role of comprehensive training regimens in optimizing athletic performance at the collegiate level. As such, our study offers valuable insights into the nuanced interplay between training strategies and athletic outcomes, thereby furnishing coaches and practitioners with evidence-based guidelines for fostering athletic excellence in university basketball programs.

Furthermore, the investigation shows how important it is for university basketball players to do both strength and plyometric training. These types of training really help to improve how players perform physically, how their bodies work, and how well they play. We think it's a good idea for coaches to always include these trainings in their basketball programs because they make a big difference in how well players do. Also, players should know why they're doing these trainings and how they can help them play better. In the future, we should look at how these trainings work for different sports and athletes. We could also see how they affect athlete's mind and bodies. Doing more studies over time will help us keep track of how well these trainings wok and keep improving how we train athletes.

IV.CONCLUSION

The results derived from the adjusted means for explosive strength revealed a mean of 41.42 for the complex training group, 38.56 for the plyometric training group, 38.19 for the strength training group, and 35.34 for the control group. These values were statistically examined by ANCOVA to determine differences between pre-test, post-test, and adjusted means. The corresponding F-values obtained for the pre-test, post-test, and adjusted means were 1.35, 37.09, and 35.96 respectively. While the F-values for pre-test scores were non-significant, those for post-test and adjusted means above the necessary F-values of 2.76 and 2.77, respectively, showing statistical significance at the 0.05 confidence level.

Post-hoc analysis further revealed significant differences between the experimental groups. Notably, the complex training group exhibited substantially grater enhancements in explosive strength compared to both the plyometric training and strength training groups among university men's basketball players. These findings underscore the superior effectiveness of complex training in improving explosive strength among university men's basketball players.

Author's Contribution

All the authors contributed equally

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Conflict of Interest

The authors declare that the research was conducted in the absence of any financial relationship that could be construed as a potential conflict of interest

No potential competing interest was reported by the author(s)

Compliance with Ethical Standards

The manuscript does not require ethical approval

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