Investigating the Speed Impact of Complex Training on University Men's Basketball Players

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ABSTRACT

Basketball is a fast-paced sports that requires an active use of all muscle groups, a large number of jumps, and frequent speed changes. For male basketball players, CT is crucial since it enhances their physical performance in a number of areas, such as power, speed, agility, and endurance. CT can improve athletes' abilities to run faster, jump higher, and change direction more quickly by combining PT and ST activities. CT can also enhance overall athletic performance and lower the chance of injury. Furthermore, it helps to address special physiological needs and improve the capacity of male basketball players to function at a high level whereas the majority of basketball movement activities are based on power and quickness. In basketball, a player's capability to execute different skills like dribbling, jumping, and shooting is determined by their speed and power. Players with speed are able to and get past opponents, make quick breaks, move swiftly up and down the court. The study objective was to establish the influence of plyometric, strength, and CT, both separately and in combination, on the speed of collegiate men's basketball players. A pre- and post-test as part of a truly randomized group design. The participants (N=80) were split equally among four randomly selected groups of 20 players. A pre-test on specific physiological, physical, and performance variables will be subjected to each participant. These preliminary test results were used to calculate the pre-test scores of the subjects. Similar designations were given to the groups: Experimental Group I (EG-I), Experimental Group II (EG-II), Experimental Group III (EG-III) and Control Group (CG). ST was administered to EG-I, plyometric training (PT) to EG-II, complicated training to EG-III, and no experimental training was given to the CG. The post-test scores of the participants were determined using these final test results. Twelve weeks were allotted for the training session. Following the experiment, physical, physiological, and performance evaluations were performed on each participant. These final test results were used to calculate post-test scores of each subject. The pre-and post-test outcomes were statistically examined using Analysis of Covariance (ANCOVA) to determine the significance of the mean differences. If the "F" ratio of the adjusted test was significant, then the Scheffe's post-hoc test was applied. In each case, a 0.05 confidence level was established to test hypotheses. The results illustrated that among university men's basketball players, the combined training group accomplished better performance and was faster than the other groups.

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1. INTRODUCTION

Basketball has become a one of the most significant sports nowadays, since there is a lot of efforts being done to aggressively modernize it. Basketball is a multifaceted sport that needs a complex fusion of technical, tactical, physical, and psychological variables. Athletes and coaches face ever-increasing competitive expectations in modern sport, which necessitates continuous improvement in training methods and the sports preparation process itself. Accordingly, it is essential to incorporate all forms of sports preparation— tactical, technical, fitness, theoretical, and psychological —into the training and determine how best to combine them. The biodynamic abilities (power and coordination) and bioenergetic potential of the athlete make up his condition, and speed is a trait that characterizes all of these attributes.

Players' high-intensity efforts combined with recovery moments reveals the complexity of the sport. These activities include skill-based skills like shooting, dribbling, and rebounding, as well as explosive hops, sprints, and changes of direction (CODs). These behaviors have a big impact on match results, especially during crucial game periods. As a result, improving the physical fitness skills that maximize these vital functions has emerged as a top priority for both coaches and athletes.

Training programs for sports need to be especially developed to maximize athlete performance. A quality training program enhances several crucial aspects of a sport. Apart from that, previous research has employed beneficial training method with a reliable performance. The complicated training approach is a suitable choice for optimizing the physical fitness of basketball performers. Combining weight training and plyometrics is one form of the complicated training strategy. Meanwhile, it enables the core muscles to efficiently retain the body's posture, basic endurance is the most important component of fundamental training because.

During prolonged exercise, basic endurance is vital for keeping the spinal stable. Both short and tall basketball players need muscle as it promotes greater percentage of speed a than muscular power of a tall athletes. By raising the power of his jump higher than the speed, the short player can compensate for his lack of height by increasing the level of his jumping height.

The ability to do basketball-specific exercises including leaps, and sprints are connected to lower extremity strength and power. Strength is the muscle group or maximum stress a muscle can produce at a specific speed. Strength can take many different forms that affect sports performance, such as power, speed, agility, and endurance. A wide range of resistance training (RT) techniques are presented in the study with the goal of improving strength and power of basketball players.

In order to overcome the limitations that come with different strength training (ST) techniques, complex training (CT) has evolved as a popular strategy in recent years. This approach has different names complex training, contrast training, or combined training. This novel method combines a high-velocity movement with a heavy resistance exercise, both of which share the same biomechanical pattern. A high-intensity ST session is usually followed by a low-intensity PT exercise. The phenomenon of post-activation potentiation enhancement (PAPE), which describes the improvement in muscular performance (jumping or sprinting) after maximum or near-maximal muscle contractions, serves as the physiological foundation for CT. This stimulation improves the activation of motor units and raises the musculature's capacity to produce force. In contrast to other training approaches, the strengthened muscle produces an immediate performance boost and, when routinely attained through a planned training programmes, it leads to even more effective long-term changes.

The empirical study demonstrate that CT can dramatically increase a number of physical characteristics in basketball participants, such as muscular strength, sprint speed, upper body power, and jump height.

It is crucial to understand the difference between chronic effects, which appear long time (for example, when using CT in a training program), and acute effects, which take place right after CT or in the short term (for example, when using CT in a warm-up routine). According to a recent systematic review, CT outperformed other training techniques in enhancing the vertical jumping power of men basketball participants. In this sense, there is a lack of consensus and evidence in the existing literature about ideal use in basketball, despite its proven potential of CT. On the one hand, general team sports or particular sports like basketball have been the main focus of a large portion of the current research. However, there is a wide range of variation in the protocols used for CT, including the sequence, volume, intensity, and kind of exercises, the rest period in between different sets, and the length and frequency of training regimen.

The authors discover several literature reviews that could greatly enhance and bolster this investigation. They shared some of the findings and observations of the subject matter specialists after reviewing the existing literature. A review of the relevant literature is a crucial component of every research project. "The key to the vast store house of published literature may open the doors to sources of explanatory hypotheses and significant problems," according to Good. It also offers comparative data for result interpretation, useful guidance for problem definition, and background information for procedure selection. One should read critically and extensively as problem-solving mindset in order to be original and truly creative.

The author should have deep understanding of both prior research and theory for any scientific investigation. The literature on any issue aids the researcher in learning what is previously known, which gives the researcher a clear perspective, a deeper comprehension of the problem they have selected, and a greater grasp of other elements related to the study. Consequently, several books, journals, and websites were cited. Since they have a big impact on the current study, an effort has been made to quickly introduce some of the key researchers and studies that have been done both in India and elsewhere in the pages that follow. The literature reviews were limited to websites on the Internet.

Under the following headings, the literature reviews pertaining to the problem statement have been categorized.

- Studies on ST
- Studies on PT
- Studies on CT

2. STUDIES ON ST

Feng et al., (2024) analyze how core ST affects teenage basketball players' dribbling, dynamic balance, and agility performance. The study used a random control design between the subjects. 44 male adolescent basketball performers, who were 14.41 ± 3.22 years old, were split into two groups at random: core ST (CST) and CT. For 12 weeks, the CST program consisted of three 1-hour training sessions per week. The CT group, on the other hand, offered a comprehensive physical training regimen that focused on general conditioning as opposed to only core strength. Players' performance was assessed through three different tests: The Illinois Agility Test, the Star Excursion Balance Test, and the Dribbling Test, which were administered at T0 (week-0), T1 (week-6), and T2 (week-12), correspondingly. Significant relationship effects ($p < 0.05$) were noted in the measurements of dynamic balance, with the CST group demonstrating a larger development than the CT group, especially in the anterior, posterolateral, and posteromedial directions. Furthermore, the CST group illustrate significantly greater agility at T2, according to Bonferroni post-hoc analysis; nonetheless, dribbling skill improvements were significant within the CST group from T1 to T2, but not comparing to the CT group. The dribbling, agility, and dynamic balance abilities of Adolescent basketball players were considerably enhanced by the 12-week CST regimen, indicating its potential as an effective training element. Future studies should examine how CST affects other aspects of a sport and whether it applies to female athletes.

Bright et al. (2023) effects of eccentric RT (ECC-RT) on physical performance metrics (such as muscle strength, jump, sprint, and change of direction (COD) in young athletes aged 18 and younger have been thoroughly examined and evaluated. Using the advanced search feature of Google Scholar, SPORT Discus, and PubMed, three electronic search engines, Original journal articles from 1950 to June 2022 were obtained. complete research papers examining the long- and short-term impacts of ECC-RT on physical fitness performance in young athletes (those who are 18 years of age or younger who participate in sports) were included. A modified Downs and Black checklist was used to evaluate each study's methodological quality and bias before data extraction. 436 of the 749 studies that the search turned up were duplicates. Five more studies were eliminated using the modified Downs and Black criteria, and three hundred studies were eliminated based on abstract and title reviews.

During backward screening, 14 more studies have been found. As a result, our systematic review contained 22 studies. The most popular ECC-RT techniques among young athletes were flywheel inertial training and the Nordic hamstring exercise. Increases in the breakpoint angle, not training volume (sets and repetitions), are what determine improvements in physical performance after the Nordic hamstring exercise. These gains are further increased by adding high-speed running or hip extension exercises. For flywheel inertial training to produce significant changes, at least three familiarization trials are required. Additionally, rather than reducing the eccentric phase gradually, the focus should be on slowing down the rotating flywheel in the last one to two thirds of the eccentric stage. ECC-RT has proved to increase young athletes' performance on tests of COD, leap, sprint, and muscular strength. These findings support the hypothesis. Future research should focus on the efficiency of accentuated eccentric loading to enhance jumping power, as the flywheel inertial training and Nordic hamstring exercise are the only ECC-RT techniques now available.

Wei & Xiaofeng (2023) examine how RT affects basketball players' lower extremity explosive strength. A random sampling method was employed to choose 18 basketball players. The experimental and CGs were randomly selected from among the volunteers. Due to their lack of explosive strength in harsh conditions, Chinese basketball players may exhibit deformed movements as a result of their inadequate lower limb strength. Basketball players will make mistakes because of this. In order to analyze the data, mathematical statistics were used. Age, height, weight, and years of training did not considerably vary between the EGs and CGs ($P>0.05$). Both athlete groups' standing jump performance improved following explosive training, however the experimental group's performance increased noticeably ($P<0.05$). Following explosive training, the vertical leap in situ was significantly enhanced by both groups, with the experimental group demonstrating a higher intensity ($P<0.05$). Following explosive training, both groups' 30-meter start performance increased. Basketball players' performance is significantly improved by the RT routine that is offered for the lower extremities. Evidence level II: therapeutic studies, which examine the results of treatment.

Logeswaran (2022) examined how ST affected the shooting accuracy of male adolescent basketball players. Thirty teenage male basketball players, ages 14 to 17, were chosen at random from National Sports School in Coimbatore to take part in the study. The n=15 subjects were equally split into two groups at random. Every participant was split into two groups, each consisting of 15 individuals: the EG and the CG. For twelve weeks, group I engaged in RT, while group II served as a CG, engaging in only the standard routine training. As dependent variables, skill-based variables like shooting accuracy were chosen. For this research work, a randomized group design was employed before and after the test. The difference between the means of both groups was ascertained through the dependent€˜ at€™ test. to determine whether the EG and the CG varied significantly from one another. A fixed 0.05 of significance level was applied to analyze the mean difference. The findings indicate that twelve weeks of weight training considerably enhance the shooting accuracy of teenage male basketball players. Additionally, it was demonstrated that the EG and the CG shooting accuracy differed significantly. The chosen criterion variables were not improved by the CG.

2.1 Studies on PT

Huang and Wu, (2025) Examine the impacts of a twelve-week PT regimen intervention on injury rates, advanced layup success rates, explosive strength, and lower limb joint mobility. Fifteen male collegiate basketball participants were recruited to participate in the research work. They trained for basketball five times a week for 2hrs each, and twice a week they also received PT. The study used a force plate to quantify the lower limbs' explosive strength during the jump and image processing software to analyze the lower limb joint mobility during the takeoff stage of a layup.

In addition, the study looked at the sports injury rate and the success and injury rates of advanced layups, such as spin, crossover, and straight-line layups. The findings showed a clear positive link between lower limb explosive strength and plyometric exercise, which considerably improved hip, knee, and ankle joint mobility. Plyometric exercise also increased lower limb explosive strength and joint mobility. While the rate of sports injuries dropped from 18% to 8%, the success rate of advanced layups rose from 50% to 72%. In summary, PT dramatically increased participants' explosive strength and lower limb joint mobility, which improved advanced layup performance and decreased the incidence of sports injuries. Even though this study offered some initial proof of the efficacy of plyometric exercise, more investigation is required to look at its long-term impacts and other contributing variables.

Munshi et al. (2022) Few studies have compared the acute effects of plyometric and whole-body vibration exercises on the occurrence of post-activation potentiation and the resulting performance improvements, despite the fact that numerous studies have suggested the separate effects of these exercises on physical performance variables. Thus, our objective was to evaluate the immediate impact of whole-body vibration training and plyometric workouts on collegiate basketball players' physical performance. In this randomized crossover study, twenty-four male collegiate basketball players (weight 71.2 ± 7.6 kg, height 1.79 ± 0.7 m, age 20.8 ± 2.02 years) took part.

Following a 48-hour washout period, the subjects underwent both PT and whole-body vibration activities. At baseline, four and twelve minutes after whole-body vibration and PT activities, countermovement jump (CMJ) height, agility, and sprint time were analyzed. The findings indicate that both the whole-body vibration and plyometric activities improved agility time and CMJ ($p = 0.001$). The whole-body vibration group performed better in the sprint, whereas the plyometric group had higher CMJ height and agility (mean difference 1.60 cm and 0.16 s, correspondingly). Nevertheless, there was no statistically substantial difference between the two groups ($p > 0.05$). According to this experimental outcome, whole-body vibration workouts and PT activities may both enhance post-activation potentiation, which enhances physical performance.

2.2 Studies on CT

Damavandi et al., (2025) analyze how testosterone, cortisol, lactate levels, and the jumping profile of male basketball players are affected by combined RT (contrast and complex). 36 male basketball performers ages between 18 and 23 took part in the research work. Three RT groups—contrast, complicated, and control—were allocated to the participants at random. For six weeks, they did two different sessions a week of weight training and plyometric activities utilizing the contrast or complicated approaches. The vertical jump test (jump profile), the 60-second repeated vertical jump test (lactate), and the resting serum levels of cortisol and testosterone were measured both before and after the intervention. Covariance and the Bonferroni test were applied to analyze the data at a confidence level. Peak power, peak jump velocity, jump height, serum testosterone, and serum cortisol were all significantly higher in the CT and contrast training groups than in the CG. In comparison to the CG, lactate levels considerably diminished in the CTG and CGs after the repeated vertical leaps test. Basketball players' testosterone and cortisol hormone levels, as well as their athletic performance, are all optimally improved by contrast and sophisticated RT. Furthermore, it was discovered that neither training approach was better than the other.

Huang et al. (2023) assessed the performance of professional basketball players in terms of speed, agility, and explosive strength during an 8-week PT regimen. We publicly recruited 15 top-tier male Taiwanese college basketball participants, with an average age of 22.16 ± 0.85 years. For eight weeks, each subject received 24 PT sessions, three times a week, which were administered before and after the exam. A 20-meter sprint and a T-shaped run comprised the agility and speed test components. To determine the differences between the pre- and post-test results for the test indicators, such as rate of force development, ground reaction forces for the jumping moment, the rate of force development, the explosive strength test, duration of passage and jump height employed a force plate to measure CMJ.

It was demonstrated that following the PT regimen, the participants' skeletal muscle mass rose greatly, their body fat percentage and body mass index minimized dramatically, and their speed and agility post-test scores improved significantly. Every participant showed a shorter period for the rate of force development (0.107~0.232 s) and a steeper gradient for the rate of force development (r = −0.816~−0.963). A ground response force of 1509.61~2387.11 was attained. The leap height was 0.624 meters, while the passage time was 0.643 seconds. The study found that a PT session can improve explosive strength by increasing the volume of muscles in the legs and lower limbs, speeding up the pace at which force is developed, and reducing the time needed to leap.

Sebic et al. (2023) find out how a three-week modified complicated training program affected the women's national basketball players' athletic performance. The most widespread games in the world is basketball, and as the activity develops, physical prowess becomes more and more crucial. Twelve highly skilled female basketball players from Bosnia and Herzegovina's national team participated in an experimental study. Prior to and following three weeks of modified complicated training, the 300-yard, 20-yard, lane agility, and beep tests were observed. The mean and standard deviation of all the variables were determined, and a paired sample t-test was used to compare performance changes before and after. A statistically substantial increase in all evaluated parameters, including beep, 300 yards, 20 yards, and lane agility test, is observed after three weeks of particular complicated training sessions. The study concludes that the implemented sophisticated training program has enhanced the researched parameters of elite female basketball players' condition preparedness.

3. METHODOLOGY

The study objective was to determine the influence of PT, ST, and CT, both separately and in combination, on the speed of collegiate men's basketball players. A pre- and post-test as part of a truly randomized group design. The participants (N=80) were split equally among four randomly selected groups of 20 players. A pre-test on specific physiological, physical, and performance variables will be subjected to each participant. These preliminary test results were used to calculate the pre-test results of the participants. Similar designations were given to the groups: EG-I, EG-II, EG-III and CG. ST was administered to EG-I, PT to EG-II, complicated training to EG-III, and no experimental training was given to the CG. The post-test scores of the participants were determined using these final test results.

Twelve weeks were allotted for the training session. Following the experiment, physical, physiological, and performance evaluations were performed on each participant. These final test performances were used to calculate post-test outcomes of each subject. The pre-and post-test results were statistically examined using ANCOVA to determine the mean difference. If the "F" ratio of the adjusted test was significant, then the Scheffe's post-hoc test was applied. In each case, a 0.05 level of significance was established to test hypotheses. The results showed that among university men's basketball players, the combined training group has demonstrated superior performance and was faster than the other groups.

Table 1. Ancova Computation of ST, PT, CT and CGS on Speed

	STG	PTG	CG	CTG	SOV	SS	DOF	MS	F-ratio
Pre-Test Means	7.28	7.20	7.17	7.22	**BG**	0.127	3	0.042	0.07
					WG	42.501	76	0.559	
Post-Test Means	6.43	6.39	5.64	7.19	**BG**	23.883	3	7.961	13.00*
					WG	46.539	76	0.612	
Adjusted Post-Test Means	6.41	6.39	5.65	7.18	**BG**	23.525	3	7.842	13.10*
					WG	44.865	75	0.598	

BG- Between Group
WG- Within Group
DOF- Degrees of Freedom
Sum of Squares-SS
Source of Variance- SOV

* - Significant
(Table Value for 0.05 Level for df 3 & 76 = 2.72)
(Table Value for 0.05 Level for df 3 & 75 = 2.72)
Mean Square- MS

4. RESULTS OF SPEED

The pre-test averages for the ST, PT, CT, and CGs were 7.28, 7.20, 7.17, and 7.22, correspondingly, according to an analysis of table 1. The F-ratio vales in the table was 2.72, while the pre-test was 0.07.

Therefore, for DOF 3 and 76, the pre-test mean F-ratio was not significant at the level of 0.05. This demonstrated that there were no considerable variance among the EG and CGs, suggesting that the group assignment procedure was flawless. The pretest mean differences in speed across the control, strength, plyometric, and complicated training groups are displayed in Figure 1.

ST, PT, CT, and CGs had respective post-test averages of 6.43, 6.39, 5.64, and 7.19. The table's F-ratio was 2.72, and the post-test's F-ratio was 13. Therefore, for DOF 3 and 76, the post-test mean F-ratio was significant at the 0.05 significance level. This established the significance of the variations in the subjects' post-test means. ST, PT, CT, and CGs' post-test mean differences on speed are displayed in Figure 2.

ST, PT, CT, and CGs had adjusted post-test values of 6.41, 6.39, 5.65, and 7.18, correspondingly. The adjusted post-test means yielded an F-ratio of 13.10, while the table F-ratio was 2.72. Therefore, for DOF 3 and 75, the adjusted post-test mean F-ratio was significant at the 0.05 significance level. The modified post-test means differences in speed between the ST, PT, CT, and CGs are displayed in Figure 3.

This established that the experimental speed training caused a substantial variation in the means. Scheffe's post-hoc test was employed to analyze the results because substantial differences were noted. The experiment outcomes were displayed in Table 2.

Table 2. Scheffe's Test on Speed

Adjusted Post-Test Means				MD	CI
STG	PTG	CG	CTG		
6.41	6.39	--	--	0.02	0.69
6.41	--	5.65	--	0.76*	
6.41	--	--	7.18	0.77*	
--	6.39	5.65	--	0.74*	
--	6.39	--	7.18	0.79*	
--	--	5.65	7.18	1.53*	

**** Significant at 0.05 level of confidence***

Confidence Interval- CI Mean Difference- MD

The adjusted means of ST with combined group (0.76), PT with combined group (0.77), ST with CG (0.74), PT with CG (0.79), and combined group with CG (1.53), as established by the multiple comparisons demonstrated in Table 2, showed significant differences. With a 0.69 of CI, there was no significant variance between the ST and PT groups (0.02) at the 0.05 significance level.

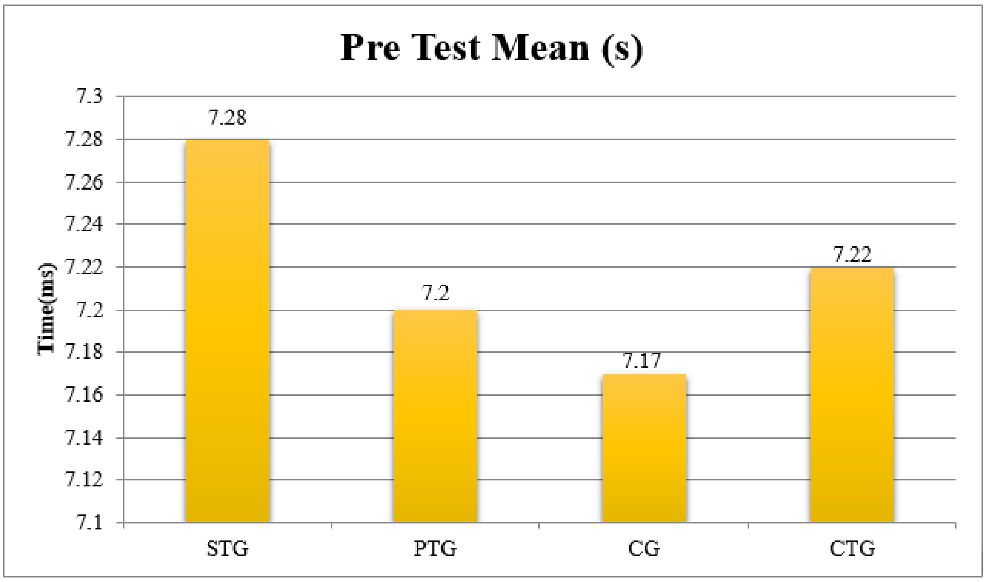

Figure 1. Pre-Test Means of ST, PT, CT and CGS on Speed

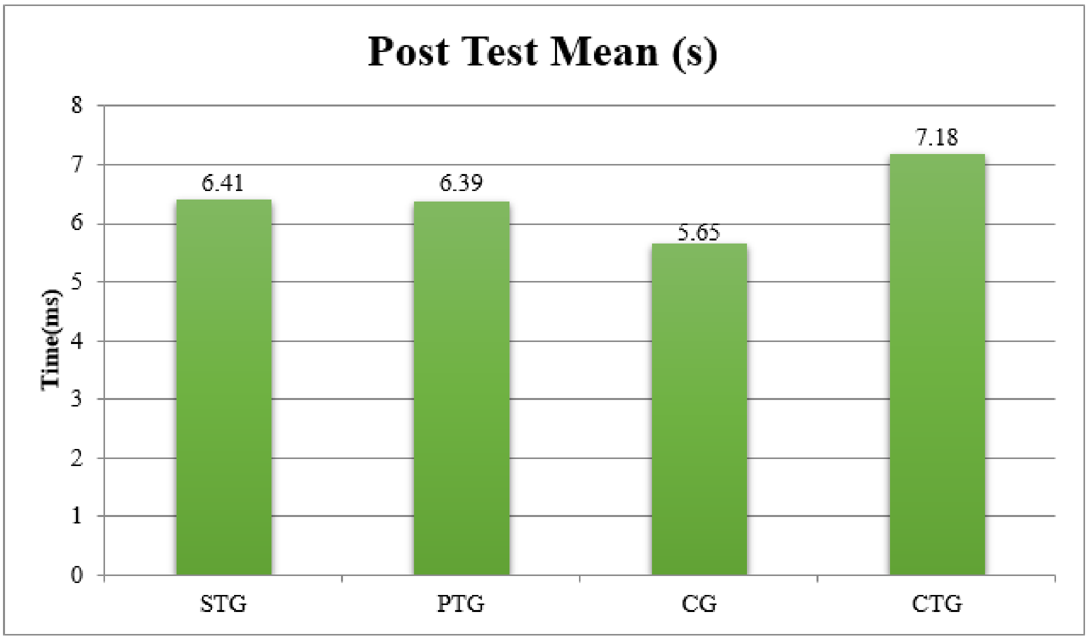

Figure 2. Post-Test Means of the ST, PT, CT, And CGS On Speed

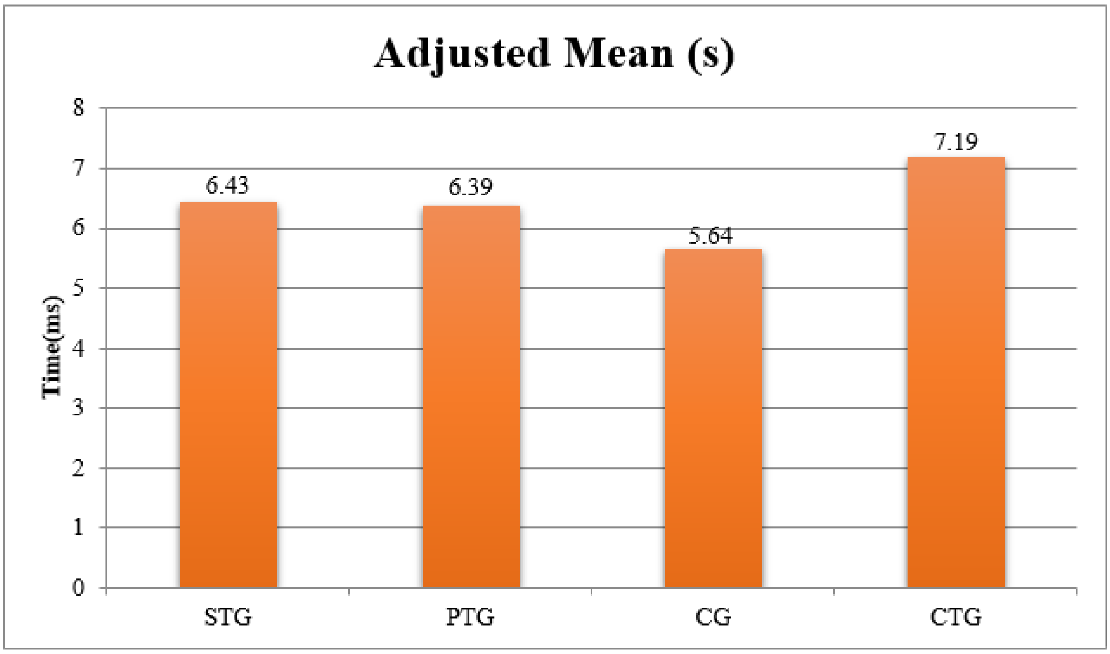

Figure 3. Adjusted Post-Test Means of the ST, PT, CT, and CGS on SPEED

Figure 4 shows the comparative analysis of the four groups on speed for better understanding of the results.

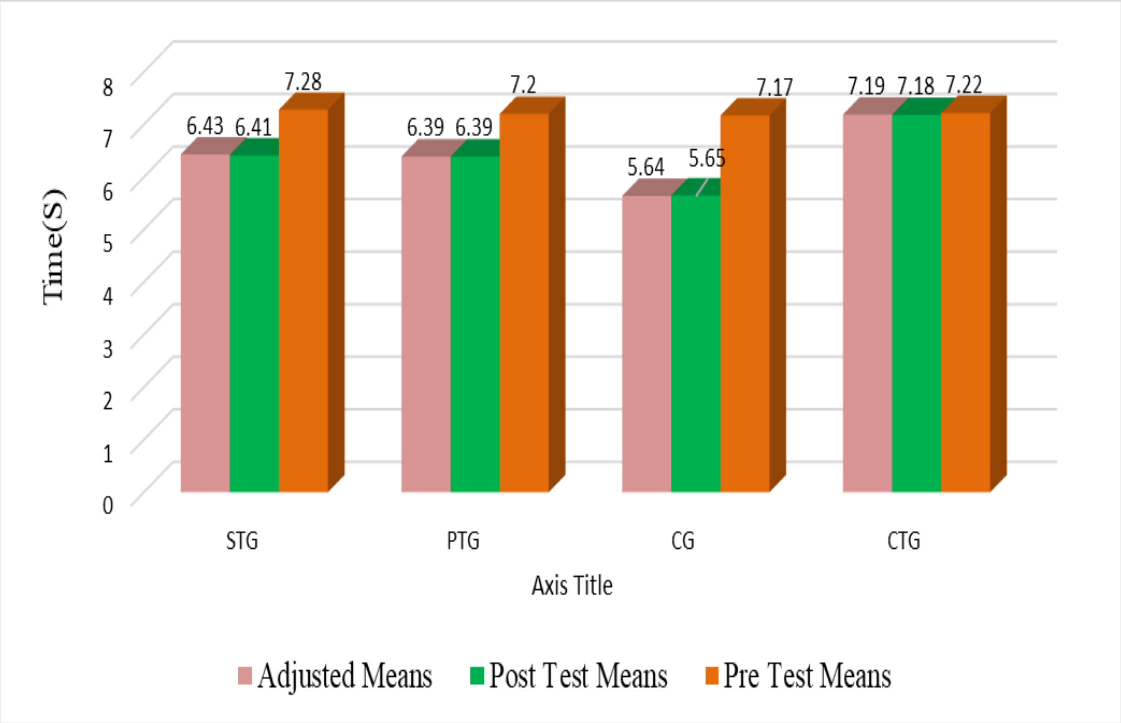

Figure 4. Comparative Analysis of the ST, PT, CT and CGS on SPEED

The experimental outcomes of our study underscore the profound effect of structured training protocols on the physical, performance, and physiological dimensions crucial to the athletic prowess of university-level basketball players. Over a rigorous twelve-week regimen, both ST and PT 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 improving athletic performance at the collegiate level. As such, our study offers valuable understandings 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 PT. 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.

5. CONCLUSION

In this study, we find out how speed of university men's basketball players' is affected by plyometric, strength, and CT, both individually and in combination. A pre- and post-test as part of a truly randomized group design. The participants (N=80) were split equally among four randomly selected groups of 20 players. A pre-test on specific physiological, physical, and performance variables will be subjected to each participant. These preliminary test results were used to calculate the pre-test scores of the participants. Similar designations were given to the groups: EG-I, EG-II, EG-III and CG. ST was administered to EG-I, PT to EG-II, complicated training to EG-III, and no experimental training was given to the CG. The results derived from the adjusted means for speed revealed a mean of 7.18 for the CT group, 6.39 for the PT group, 6.41 for the ST group, and 5.65 for the CG. These values were statistically examined by ANCOVA to determine differences between pre-test, post-test, and adjusted means. The corresponding F-values attained for the pre-, post-, and adjusted test means were 0.07, 13.00, and 13.10 correspondingly. While the F-values for pre-test scores were found to be non-significant, those for post-test and adjusted means above the required F-values of 2.72 and 2.72, correspondingly, showing statistical significance at the 0.05 level of confidence.

Post-hoc investigation further illustrated substantial differences between the EGs. Notably, the CTG exhibited substantially greater enhancements in speed compared to both the PT and ST groups among university men's basketball players. These outcomes underscore the superior effectiveness of CT 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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REFERENCES

[1] Flórez Gil, E., Vaquera, A., Ramírez-Campillo, R., Sanchez-Sanchez, J. and Rodríguez Fernández, A., 2024. Can complex training improve acute and long-lasting performance in basketball players? A systematic review. Applied Sciences, 14(15), p.6839.

[2] Shi, L., Lyons, M., Duncan, M., Chen, S., Chen, Z., Guo, W. and Han, D., 2022. Effects of variable resistance training within complex training on neuromuscular adaptations in collegiate basketball players. Journal of human kinetics, 84, p.174.

[3] Romadhoni, S. and Yudhistira, D., 2024. Implementing Complex Training Method: Its Effects on Endurance, Speed, Power, and Agility of Adolescent Basketball Players. Physical Education Theory and Methodology, 24(3), pp.426-432.

[4] Wang, B., Xie, E., Liang, P., Liu, T., Zhu, J., Qin, G. and Su, X., 2024. Transforming performance: The impact of an 8-week complex training program on strength, power, and change of direction in female basketball athletes. Medicine, 103(24), p.e38524.

[5] Hassan, A.K., Bursais, A.K., Alibrahim, M.S., Selim, H.S., Abdelwahab, A.M. and Hammad, B.E., 2023. The impact of core complex training on some basketball-related aspects of physical strength and shooting performance. European Journal of Investigation in Health, Psychology and Education, 13(9), pp.1624-1644.

[6] Damavandi, P., Rahmani-Nia, F. and Mirzaei, B., 2025. The effect of complex and contrast resistance training on testosterone, cortisol, lactate levels, and jumping profile of basketball players. Journal of Practical Studies of Biosciences in Sport.

[7] Yewen, O., Widiyanto, W., Padli, P., Sabillah, M.I., Zarya, F., Haryanto, J., Geantă, V.A., Ndayisenga, J., Falahudin, A., Salahudin, S. and Furkan, F., 2024. Increased leg muscle power and arm muscle strength of basketball athletes: through complex training method and circuit body weight training. Retos: nuevas tendencias en educación física, deporte y recreación, (60), pp.1213-1221.

[8] Huang, W.Y. and Wu, C.E., 2025. The Effects of Plyometric Training on Lower Limb Joint Mobility, Explosive Strength, Advanced Layup Success Rate, and Sports Injury Rate Among College Male Basketball Players. Applied Sciences, 15(10), p.5356.

[9] Feng, W., Wang, F., Han, Y. and Li, G., 2024. The effect of 12-week core strength training on dynamic balance, agility, and dribbling skill in adolescent basketball players. Heliyon, 10(6).

[10] O Brien, J., Browne, D. and Earls, D., 2020. The effects of different types of eccentric overload training on strength, speed, power and change of direction in female basketball players. Journal of functional morphology and kinesiology, 5(3), p.50.
[11] Biel, P., Ewertowska, P., Stastny, P. and Krzysztofik, M., 2023. Effects of Complex Training on jumping and change of Direction Performance, and Post-activation Performance Enhancement response in basketball players. Sports, 11(9), p.181.
[12] Hassan, A.K., Bursais, A.K., Alibrahim, M.S., Selim, H.S., Abdelwahab, A.M. and Hammad, B.E., 2023. The impact of core complex training on some basketball-related aspects of physical strength and shooting performance. European Journal of Investigation in Health, Psychology and Education, 13(9), pp.1624-1644.
[13] Damavandi, P., Rahmani-Nia, F. and Mirzaei, B., 2025. The effect of complex and contrast resistance training on testosterone, cortisol, lactate levels, and jumping profile of basketball players. Journal of Practical Studies of Biosciences in Sport.
[14] Krzysztofik, M., Jarosz, J., Urbański, R., Aschenbrenner, P. and Stastny, P., 2025. Effects of 6 weeks of complex training on athletic performance and post-activation performance enhancement effect magnitude in soccer players: a cross-sectional randomized study. Biology of Sport, 42(1), pp.211-221.
[15] Yewen, O., Widiyanto, W., Padli, P., Sabillah, M.I., Zarya, F., Haryanto, J., Geantă, V.A., Ndayisenga, J., Falahudin, A., Salahudin, S. and Furkan, F., 2024. Increased leg muscle power and arm muscle strength of basketball athletes: through complex training method and circuit body weight training. Retos: nuevas tendencias en educación física, deporte y recreación, (60), pp.1213-1221.
[16] Yáñez-García, J.M., Rodríguez-Rosell, D., Mora-Custodio, R. and González-Badillo, J.J., 2022. Changes in muscle strength, jump, and sprint performance in young elite basketball players: the impact of combined high-speed resistance training and plyometrics. The Journal of Strength & Conditioning Research, 36(2), pp.478-485.
[17] Huang, H., Huang, W.Y. and Wu, C.E., 2023. The effect of plyometric training on the speed, agility, and explosive strength performance in elite athletes. Applied Sciences, 13(6), p.3605.
[18] Papla, M., Perenc, D., Zając, A., Maszczyk, A. and Krzysztofik, M., 2022. Contribution of strength, speed and power characteristics to change of direction performance in male basketball players. Applied sciences, 12(17), p.8484.
[19] Kumar, G., Pandey, V., Thapa, R.K., Weldon, A., Granacher, U. and Ramirez-Campillo, R., 2023. Effects of exercise frequency with complex contrast training on measures of physical fitness in active adult males. Sports, 11(1), p.11.
[20] Minh, T.T. and Ngoc, C.T., 2022. Effects of a 15-week basketball training program following the club model in physical education courses for female students at Saigon University. Journal of Physical Education and Sport, 22(1), pp.202-209.
[21] Cao, S., Liu, J., Wang, Z. and Geok, S.K., 2024. The effects of functional training on physical fitness and skill-related performance among basketball players: a systematic review. Frontiers in physiology, 15, p.1391394.
[22] de Villarreal, E.S., Molina, J.G., de Castro-Maqueda, G. and Gutiérrez-Manzanedo, J.V., 2021. Effects of plyometric, strength and change of direction training on high-school basketball player's physical fitness. Journal of Human Kinetics, 78, p.175.
[23] Rauner, A., Mess, F. &Woll, A. The relationship between physical activity, physical fitness and overweight in adolescents: a systematic review of studies published in or after 2000. BMC Pediatr 13, 19 (2013). https://doi.org/10.1186/1471-2431-13-19
[24] B, C., & N, A. (2013). Effect of basketball specific endurance circuit training on aerobic capacity and heart rate of high school male basketball players. International Journal of Physical Education, Fitness and Sports, 2(4), 22–25. https://doi.org/10.26524/1345
[25] Chundu Venkata Rao, Dr. Y. Kishore. Combined Effect of Strength and Plyometric Training Programme on Selected Motor Fitness Components of Male Kabaddi Players. International Journal of Recent Research and Applied Studies, 2014, 2 (11), 43-45
[26] Gnaneshwar, M. N., & Gopinath, R. (2013). Effect of Plyometric Training Isotonic Training and Combination of Isotonic And Plyometric Training on Speed and Muscular Endurance. International Journal of Health, Physical Education and Computer Science in Sports, 11, 1-125.
[27] Paktas, Y. (2021). The effectiveness of two types of resistance training program and plyometric on the performance of female basketball players. Pakistan Journal of Medical & Health Sciences, 15, 778-780.
[28] Šebić, L., Čaušević, D., Kovačević, E., Aljiji, A., Vrcić, M., &Simović, S. (2023). Effects of A 3-Week Modified Complex Training on Athletic Performance of Women's National Basketball Players. Int. J. Phys. Educ. Fit. Sports, 12(1), 29-36.