14 (3) (2025) 1083 - 1088
Journal of Physical Education, Sport, Health and Recreations
https://journal.unnes.ac.id/journals/peshr

The Effect of Contrast Training Method on Increasing of Vertical Jump, Speed, and Agility in 3x3 Basketball Athletes

Wendi Rahmattulloh[1]✉, Dede Rohmat Nurjaya[2], Masayu Rizka Risjanna[3]

Sport Physical Coaching Study Program, Faculty of Sport and Health Education, Universitas Pendidikan Indonesia, Bandung, West Java, Indonesia[13]
Sport Coaching Education, Faculty of Sport and Health Education, Universitas Pendidikan Indonesia, Bandung, West Java, Indonesia[2]

Article History

Received October 2025
Accepted October 2025
Published Vol.14 No.(3) 2025

Keywords:
Basketball; Vertical Jump; Speed; Agility

Abstract

The purpose of this study was to investigate the effect of contrast training method on increasing of vertical jump, speed and agility in 3x3 basketball athletes. The method used in this study was an experimental method with a Pretest Posttest Design research design. The study population consisted of 13 3x3 basketball athletes from Bandung City: 6 male athletes and 7 female athletes in preparation for PORPROV 2026. Who were also the research sample, selected using a total sampling technique. The instrument used in this study was vertical jump test, sprint 20 meter test and lane agility test. Data analysis was conducted using the paired sample T-Test statistical test with the aid of the SPSS version 25 application. The results showed tha there was a significant effect ($p < .001$) on improving vertical jump, speed, and agility in 3x3 basketball athletes. This study also concludes that there was no significant difference in the effect ($p > .05$) of this training method's application between the male and female athlete groups. Thus, contrast training proved to be an effective and recommended training method for enhancing crucial physical components (explosive power) equally for 3x3 basketball athletes, regardless of gender.

How to Cite

Rahmattulloh, W., Nurjaya, D. R., & Risjanna, M. R. (2025). The Effect of Contrast Training Method on Increasing of Vertical Jump, Speed, and Agility in 3x3 Basketball Athletes. Journal of Physical Education, Sport, Health and Recreation, 14 (3), 1083-1088.

© 2025 Universitas Negeri Semarang

✉ Correspondence address :
E-mail: wendirahmatullah05@upi.edu

p-ISSN 2460-724X
e-ISSN 2252-6773

INTRODUCTION

Basketball is largely considered an anaerobic exercise due to its reliance on repeated high-intensity actions such as jumping (for rebounds, blocks, and shooting), sprinting, quick accelerations, decelerations, and rapid changes in direction. These explosive anaerobic movements directly contribute to the development of a player's strength, sprinting speed, and agility. Crucially, improving explosive strength levels, particularly the vertical jump, is vital for overall basketball performance (Angel et al., 2017). 3x3 basketball is a high-intensity discipline characterized by its rapid, intermittent nature (Paul G Montgomery, 2018b). To achieve success in this demanding sport, athletes must possess highly developed aerobic and anaerobic capacities, which are essential for sustaining peak performance across the frequent sprints, jumps, and bursts of maximal effort required during gameplay (Šumar, D., Međedović & Đukić, 2021). The sport is characterized by its reduced game format and playing surface, which is more limited than that of 5-on-5 basketball (Senel, 2025).

Two common training methods, resistance training and plyometric training (PT), are typically utilized to enhance explosive strength in basketball players (Ramirez-Campillo et al., 2020). Building on that, plyometric exercises including jumping, bounding, and hopping have become a more standard strength training method frequently used by coaches, including those in the National Basketball Association (NBA) for strength and conditioning (Haff & Triplett, 2016). Specifically, human movements like jumping, hopping, leaping, and other bounding activities are enhanced by incorporating a counter-movement. These actions are commonly described as Stretch-Shortening Cycle (SSC) movements, which fundamentally involve a muscle function that combines an eccentric (lengthening) contraction immediately followed by a concentric (shortening) contraction (Hammami et al., 2017). Therefore, Plyometric Training has been consistently shown to enhance the production of muscle force and power (Allégue et al., 2023). Furthermore, engaging in regular plyometric training can lead to substantial gains in postural control, jumping ability, sprinting speed, change-of-direction speed, and overall agility performance among young basketball players (McCormick et al., 2016).

Contrast training is defined as a combined training that involves the use of heavy and light contrasting loads, where all forms of high-load strength exercises are performed at the beginning of the session and all lighter-load exercises are performed at the end of the session (Cormier et al., 2020). The purpose of contrast training is to utilize the phenomenon of PAP (Post-Activation Potentiation) (Mohanasundaram et al., 2021). PAP (Post-Activation Potentiation) is a physiological phenomenon where a preceding muscle contraction increases the muscle's ability to generate force during subsequent contractions, which is caused by stimulation of the central nervous system (Rustiawan et al., 2023).

Previous research applying contrast training showed that the performance of junior male soccer athletes in sprint ability, agility, and power improved (Hammami et al., 2017). This study indicates that contrast training can enhance sprint, agility, and power abilities in junior soccer athletes. This improvement is crucial in soccer, where good speed, agility, and power ability play an important role in match performance, especially during attacking and defending.

Despite a growing body of literature on combination training using contrast training, the results regarding competitive team sports remain inconclusive (or ambiguous). To date, no systematic review or meta-analysis has been performed among the existing literature studies on contrast training. Therefore, further research on the contrast training method in 3x3 basketball is necessary. Most previous studies indicate that methods combining strength and power training are effective for inducing neuromuscular adaptations in individual sports.

There is a limited amount of research that discusses or analyzes the implementation of contrast training for team sports, particularly 3x3 basketball. Recent studies have attempted to highlight this issue by comparing the effects of this method on trained martial arts athletes; thus, further research is still needed. The main objective of this study is to investigate the effect of a contrast training intervention on vertical jump, speed, and agility in 3x3 basketball, and to identify the variables that may influence neuromuscular adaptation.

METHODS

The method used in this study is the experimental method. The research design employed is a One-Group Pretest-Posttest Design. In this design, tests are administrated before and after treatment to determine the effect of the intervention. The variables examined in this study included the contrast training method (complementary training model) (X) and its effect vertical jump,

speed and agility (Y).

The population of this study consists of 13 3x3 basketball athletes from Bandung City: 6 male athletes and 7 female athletes in preparation for PORPROV 2026. The sample in this study included all members of the population, meaning that the total sampling technique was employed. The selection was based on the consideration that all participate in regular training session throughout the duration of the research.

In the initial stage of the implementation, the researcher conducted pre-test and measurements of vertical jump, speed and agility. The test were administered after the participants completed a warm-up session and before engaging in any strenuous training activities. Following this, the subjects underwent a strength training intervention using the contrast training method for 7 weeks, totaling 20 sessions. The training sessions were held three times per week, specifically on Mondays, Wednesday, and Friday. After completing the intervention, post tests and final measurements were conducted to evaluate the improvements resulting from the training program. All data collection procedures were carried out in accordance with established testing protocols. The research instruments utilized in this study comprised test items designed to measure the athletes' performance in vertical jump, speed, and agility. The Vertical Jump Test was employed to measure jump height, the 20-meter Sprint was used to assess speed ability, and the Lane Agility Test was administered to evaluate the agility of the sample. Data analysis techniques utilized SPSS software.

Table 1. Contrast Training Program

Item	Reps	Set	Rest
Back Squat	8	4	90
Bench Press	8	4	90
Bulgarian Split Squat	8	4	90
Side Lunges	8	4	90
Weighted Squat Jump	10	4	60
Push Up Claps	10	4	60
Bulgarian Tuck Jump	10	4	60
Med ball Skater Jump	10	4	60

RESULTS AND DISCUSSION

This study measures the effectiveness of the contrast training method on crucial physical abilities vertical jump, speed, and agility which affect the playing performance of 3x3 basketball athletes. The results of the data analysis from 13 athletes (6 male and 7 female) to test the significance of the performance increase are presented in two parts: (1) the main hypothesis test results (Paired Samples T-Test) between the pretest and posttest data, and (2) the results of the gain score comparison analysis to test for differences in training effects between male and female athletes.

Table 2. Descriptive Statistics

	Test	N	Min	Max	Mean	Std. Dev
VJ	Pre	13	35	70	46.38	9.751
	Post	13	44	77	55.92	9.206
S	Pre	13	3.31	4.04	3.70	.23447
	Post	13	2.92	3.60	3.28	.20258
A	Pre	13	11.72	14.70	13.26	.93069
	Post	13	10.41	13.18	11.84	.82864

Based on **Table 2** present descriptive statistics of the three research variables (N=13) before (pretest) and after (posttest) threatment. The result show an increase in performance all variables. The mean Vertical Jump (VJ) increased from 46.38 (±9.751) cm at pretest in 55.92 (±9.206) cm in posttest. Performance enhancement was also observed in the time-based variables, where a decrease in average time occurred. The mean Speed (S) decreased (improved) from 3.70 (±0.234) seconds to 3.28 (±0.202) seconds. Similarly, the mean Agility (A) decreased (improved from 13.26 (±0.930) seconds to 11.84 (±0.828) seconds. A prerequisite test for normality, using the Shapiro-Wilk test, was performed on the gain score data for all three variables. The results indicated that the gain scores for vertical jump ($p = .135$), speed ($p = .758$), and agility ($p=.465$) were normally distributed ($p>.05$). Therefore, the main hypothesis was tested using the Paired Samples T-Test.

Table 3. Paired Samples T-Test

	t	df	Sig.(2-tailed	Interpretation
VJ	-18.554	12	.000	Significant
S	13.691	12	.000	Significant
A	17.970	12	.000	Significant

The paired samples T-Test **Table 3** confirms the treatments effectiveness. The pretest and posttest results show a highly significant statistical difference for all three variables, with $p < .001$ for all measurements. Specifically, this finding is supported by strong t-values for vertical jump ($t (12) = -18.554$), speed ($t (12) = -13.691$) and Agility ($t (12) = -17.970$). Therefore, the research hypothesis that the contrast training method has a significant effect on improving athlete

vertical jump, speed, and agility is accepeted. To analyze the difference in gain scores between male and female athletes, a prerequisite Shapiro-Wilk test for normality was conducted on each group. The results showed that the gain scores for Vertical Jump and Speed were normally distributed ($p > .05$) for both groups (male and female). Therefore, the comparison for these two variables was conducted using the parametric Independent Samples T-Test. However, the gain score data for Agility was found to be not normally distributed for the male group ($p=.022$). Consequently, the comparison for the Agility variable was conducted using the non-parametric Mann-Whitney U Test.

Table 4. Comparison of Mean Gain Scores by Gender

	Mean (Male)	Mean (Female)	Test Statistic (tlU)	Sig.(p)	Finding
Gain_VJ	9.5000	9.5714	-0.066	.948	NS
Gain_S	0.4000	0.4414	-0.653	.527	NS
Gain_A	4.83	8.86	8.000	.063	NS

Note. NS=Not Significant

Table 4 presents the comparison of gain scores (performance improvement) between male (N=6) and female (N=7) athletes. The results of the Independent Samples T-Test showed no significant difference in the gain scores for Vertical Jump ($t(11) = -0.066$, $p = .948$) or Speed ($t(11) = -0.653$, $p = .527$). Furthermore, the Mann-Whitney U test for Agility (used due to non-normal data per group) also indicated no significant difference ($U = 8.000$, $p = .063$). Although the mean values (or mean rank for Agility) appear slightly different, the difference is not statistically strong enough. These findings suggest that the contrast training method provided an equivalent effect (was equally effective) for both male and female athletes.

The primary finding of this study is that the application of the contrast training method over [State your intervention duration, e.g., 8 weeks] resulted in a highly significant improvement ($p< .001$) in the vertical jump, speed, and agility abilities of 3x3 basketball athletes. This finding confirms that contrast training is a highly effective method for enhancing explosive muscle power and neuromuscular performance. This significant improvement can be explained by the fundamental physiological mechanisms of contrast training, which strategically combines heavy-resistance strength exercise with high-velocity plyometric exercise within the same session (Mohanasundaram et al., 2021)

This combination is believed to trigger the phenomenon of Post-Activation Potentiation (PAP), where a preceding maximal muscle contraction (from the heavy load) enhances the muscle's ability to produce force rapidly, or Rate of Force Development (RFD), during a subsequent explosive movement (the plyometric exercise) (Allégue et al., 2023). This enhancement of RFD is the physiological foundation that underpins the simultaneous improvement in all three measured variables (Bauer et al., 2019), as vertical jump, speed, and agility are all highly dependent on an athlete's ability to generate maximal force in the shortest possible time (Pagaduan et al., 2019).

This finding aligns with and reinforces the results of various previous studies that have proven the effectiveness of contrast training in athlete populations, such as paragliding athletes (Rustiawan et al., 2023). he significant increase in vertical jump is consistent with studies by (Hammami et al., 2017) and (Allégue et al., 2023) which reported substantial improvements in lower-body explosive power after contrast training interventions in team sport athletes. Similarly, the improvements in speed (acceleration) and agility (change of direction ability) support the research of (Allégue et al., 2023) who found that combining strength and plyometric training was superior for enhancing sprint and agility performance compared to strength or plyometric training alone (Cormier et al., 2020). While much of the previous literature has focused on 5v5 basketball (Angel et al., 2017), this study provides specific evidence that the unique physiological demands of 3x3 basketball—which requires repeated accelerations and decelerations in a smaller playing area (Paul G Montgomery, 2018) can be effectively enhanced through this method.

A secondary finding of this study was the lack of a statistically significant difference ($p > .05$) in the magnitude of gain scores (improvement) between male and female athletes for all three variables. This result suggests that contrast training provided a similar adaptive stimulus for both groups in this study. This may indicate that, at the adult athletic fitness level, the neuromuscular response to explosive power training does not differ significantly based on gender. However, this finding must also be interpreted with caution. The absence of a significant difference could be heavily influenced by limited statistical power resulting from the small sample size in each group (N=6 male, N=7 female). It is possible that small effect differences do exist but were not detected by the author due to high individual variability within a limited sample.

This study has several limitations that must be acknowledged. First, the primary limitation is the one-group pretest-posttest design, which did not include a control group. Without a control group, it is difficult to conclude with certainty that the observed improvements were solely due to the contrast training intervention and not to other external factors such as natural maturation, participation in other regular training, or a learning effect from the testing itself. Second, the study's sample size (N=13) was relatively small, which limits the generalizability of these findings to the broader 3x3 athlete population. A larger sample size would provide more robust evidence and a more precise estimation of the effect. Third, this study did not control for other confounding variables such as outside training activities, nutritional status, or athlete fatigue levels, which could have influenced the training outcomes.

CONCLUSION

Based on the results of the data analysis and discussion, it can be concluded that the contrast training method is clearly effective ($p < .001$) on improving vertical jump, speed, and agility in 3x3 basketball athletes. Furthermore, this study also concludes that the effect of this training method's application showed no meaningful distinction ($p > .05$) of this training method's application between the male and female athlete groups. Thus, contrast training proved to be an effective and recommended training method for enhancing crucial physical components (explosive power) equally for 3x3 basketball athletes, regardless of gender.

REFERENCES

Allégue, H., Turki, O., Oranchuk, D. J., Khemiri, A., Schwesig, R., & Chelly, M. S. (2023). The Effect of Combined Isometric and Plyometric Training versus Contrast Strength Training on Physical Performance in Male Junior Handball Players. Applied Sciences (Switzerland), 13(16). https://doi.org/10.3390/app13169069

Angel, P., Román, L., Javier, F., Macias, V., & García, F. (2017). Effects of a contrast training programme on jumping , sprinting and agility performance of prepubertal basketball players performance of prepubertal basketball players. Journal of Sports Sciences, 00(00), 1–7. https://doi.org/10.1080/02640414.2017.1340662

Bauer, P., Sansone, P., Mitter, B., Makivic, B., Seitz, L. B., & Tschan, H. (2019). Acute Effects of Back Squats on Countermovement Jump Performance Across Multiple Sets of a Contrast Training Protocol in Resistance-Trained Men. Journal of Strength and Conditioning Research, 33(4), 995–1000. https://doi.org/10.1519/JSC.0000000000002422

Cormier, P., Freitas, T. T., Rubio-Arias, J. Á., & Alcaraz, P. E. (2020). Complex and Contrast Training: Does Strength and Power Training Sequence Affect Performance- Based Adaptations in Team Sports? A Systematic Review and Meta-analysis. Journal of Strength and Conditioning Research, 34(5), 1461–1479.

Haff, G., & Triplett, N. T. (2016). Essentials of strength training and conditioning.

Hammami, M. Z., Negra, Y., J, S. R., & Chelly, M. S. (2017). The Effect of Standard Strength vs. Contrast Strength Traininng On The Development of Sprint, Agility, Repeated Change of Direction and Jump In Junior Male Soccer Players. Journal of Strength and Conditioning Research, 31(4), 901–912.

McCormick, B. T., Hannon, J. C., Newton, M., & Shultz, B. (2016). The effects of frontal-and sagittal-plane plyo metrics on change-of-direction speed and power in adolescent female basketball players. International Journal of Sports Physiology and Performance, 11(1), 102–107.

Mohanasundaram, S., Future, A. S.-I. J. of, & 2021, undefined. (2021). Impact of complex and contrast training On biochemical variables among sportsmen. Researchgate.Net, 14(1), 953–960. https://www.researchgate.net/profile/Drmohanasundaram-Sms/publication/351111026_Impact_of_complex_and_contrast_training_On_biochemical_variables_among_sportsmen/links/608811912fb9097c0c121389/Impact-of-complex-and-contrast-training-On-biochemical-variable

Pagaduan, J., Schoenfeld, B. J., & Pojski , H. (2019). Systematic review and meta-analysis on the effect of contrast training on vertical jump performance. Strength and Conditioning Journal, 41(3), 63–78. https://doi.org/10.1519/SSC.0000000000000442

Paul G Montgomery, B. D. M. (2018a). 3×3 Basketball: Performance Characteristics and Changes During Elite Tournament Competition. Int J Sports Physiol Perform., 13(10). https://doi.org/https://doi.org/10.1123/ijspp.2018-0011

Paul G Montgomery, B. D. M. (2018b). 3×3 Basketball: Performance Characteristics and Changes During Elite Tournament Competition. Int J Sports Physiol Perform.

Ramirez-Campillo, R., Moran, J., Chaabene, H., Granacher, U., Behm, D. G., García-Hermoso, A., & Izquierdo, M. (2020). Methodological characteristics and future directions for plyometric jump training research: A scoping review update. Scandinavian Journal of Medicine and Science in Sports, 30(6), 983–997. https://doi.org/10.1111/sms.13633

Rustiawan, H., Rohendi, A., Risma, R., & Rezha, M. (2023). Peningkatan Kondisi Fisik Menggunakan Metode Contrast Training pada Atlet Paralayang Kabupaten Ciamis Menghadapi Porprov Jawa Barat 2022. Jurnal Keolahragaan, 9(1), 9. https://doi.org/10.25157/jkor.v9i1.5289

Senel, Ç. Ö. C. * and Ö. (2025). Acute Effects of the French Contrast Method and Post Activation Potentiation on 3 × 3 Basketball Game Demands and Thermal Asymmetry Responses.

Šumar, D., Međedović, B., & Đukić, G. (2021). Strength and power training in basketball. Post Scriptum, 10(10), 197–223. https://doi.org/https://doi.org/10.52580/issn.2232-8556.2021.10.10.197.