The Effect of Plyometric Training on Increasing Explosive Power in Female Basketball Athletes of Redjay Bekasi

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Abstract

This study aims to analyze the effect of plyometric training on increasing explosive power and supporting physical abilities in Redjay Bekasi women's basketball athletes. The main premise of this study is that the game of basketball requires leg explosiveness, acceleration speed, and agility to support rebounding, lay-up, transition sprints, change of direction, and defensive movement. The research uses a quantitative approach with a one-group pretest-posttest design. The study subjects consisted of 18 female basketball athletes aged 15–20 years who participated in a plyometric training program for eight weeks with a frequency of three sessions per week. Measurement instruments include Vertical Jump Test, Standing Broad Jump, 20 Meter Sprint, and T-Test Agility. Data were analyzed using descriptive statistics, ANOVA, paired sample t-test, and effect size. The results showed that the average Vertical Jump increased from 311.67 to 374.33, the Standing Broad Jump increased from 171.78 to 183.22, the 20 Meter Sprint decreased from 343.00 to 327.33, while the T-Test Agility increased from 1001.44 to 1075.72. The results of the ANOVA test showed that only Standing Broad Jump experienced significant differences (p = 0.005), while Vertical Jump (p = 0.187), 20 Meter Sprint (p = 0.670), and T-Test Agility (p = 0.547) were not significant. The results of the paired sample t-test also showed a significant improvement only in the Standing Broad Jump (p = 0.000), with Cohen's d = -3.493 and Hedges' correction = -3.416, which showed a very strong effect in practice. Thus, the research hypothesis is partially accepted. Plyometric training has been shown to be effective in increasing the horizontal explosiveness of women's basketball athletes, but it has not had a significant effect on vertical explosiveness, sprint, and agility. The training program needs to be combined with vertical jump, acceleration, deceleration, and change of direction training for more comprehensive performance adaptation.

Keywords: plyometric training; explosive power; female basketball athletes; standing broad jump; agility.

INTRODUCTION

Basketball is a sport that demands a combination of technical ability, tactics, physical condition, and high neuromuscular readiness. In the modern basketball game, athletes are not only required to be able to shoot, pass, dribble, and defensive movements effectively, but also must be able to display explosive movements such as jumping, accelerating, stopping suddenly, changing direction, and maintaining the intensity of movement during the game. These abilities are closely related to leg power, sprint speed, coordination, balance, and agility. In women's basketball, the need to develop explosive abilities is becoming increasingly important because the characteristics of the game demand a quick response to game situations, whether when rebounding, lay-ups, jump shots, attacking transitions, or defending against opponents' movements.

Good physical condition has a direct contribution to sports performance. The power of the limbs, for example, plays a role in the quality of the jump and the ability to generate force in a short period of time. Sprint speed favors game transitions, while agility is necessary to change direction efficiently without losing balance. Several recent studies have shown that plyometric-based exercises can improve jump, sprint, and direction-change performance through the optimization of stretch-shortening cycles, neuromuscular reactivity, and the efficiency of elastic energy use in muscles and tendons (Xie et al., 2024; Zhao et al., 2025; Zhang et al., 2025). In the context of female athletes, plyometric training is also reported to have the potential to increase physical capacity relevant to team sports, including basketball, volleyball, futsal, soccer, and handball (Cao et al., 2024; Lin et al., 2025; Sylvester et al., 2024; Pardos-Mainer et al., 2021).

Although the need for power and agility is very dominant in the game of basketball, there are still many training programs at the club level or youth coaching that have not systematically integrated explosive training based on scientific principles. Physical exercise is often given in a general form, paying less attention to the characteristics of the sport, the gender of the athlete, the age phase, the dosage of the exercise, the frequency, volume, and the relationship between the exercise and the specific performance needs in the field. This condition can lead to an uneven increase in performance; For example, an athlete may experience an increase in strength or jump, but not necessarily a significant improvement in sprint or agility.

Another issue that needs to be considered is the variation in the adaptation response of female athletes to training programs. Studies of female athletes show that improvements in physical performance are not always uniform as they are influenced by initial training levels, neuromuscular characteristics, biological age, program structure, training surface, intensity, and duration of interventions (Sánchez-Sixto et al., 2021; Figueira et al., 2025; You et al., 2026). In women's basketball athletes, lower limb power is an important component, but the relationship between plyometric training and the improvement of various performance indicators such as vertical jump, standing broad jump, 20-meter sprint, and agility still needs to be tested in the context of real club training. In addition, not all studies provide a clear picture of the effectiveness of an eight-week training program with a frequency of three times per week in a group of female basketball athletes in adolescence to young adulthood.

In the sports literature, plyometric training is seen as one of the effective training methods to improve explosive abilities. This exercise works through a stretch-shortening cycle mechanism, which is a rapid stretching cycle followed by explosive concentric contractions. This mechanism helps to improve the ability of muscles to generate force quickly, improve intra and intermuscular coordination, and improve the efficiency of neuromuscular reactions. Recent meta-analyses show that plyometric training has a positive effect on vertical jump, sprint, and change-of-direction performance, especially when the program is structured taking into account the complexity of the exercise, volume, rest interval, and duration of the intervention (Xie et al., 2024; Chen et al., 2023; Zhang et al., 2025).

In basketball, a few studies show that plyometric training and combined plyometric training can improve vertical jump biomechanics and physical performance of female basketball athletes (Sánchez-Sixto et al., 2021; Cherni et al., 2021). A systematic study focusing on female basketball athletes also reported that plyometric training was associated with improved physical fitness and skill-related performance, although the magnitude of the effect may differ depending on the program design, the age of the athlete, and the test indicators used (Cao et al., 2024). Other research on the frequency of weekly training suggests that the number of plyometric sessions during the competition season needs to be controlled for performance adaptation to be achieved without increasing the risk of overfatigue (Figueira et al., 2025). These findings reinforce the idea that plyometric training is not just a jump exercise but should be systematically programmed as part of basketball-specific performance development.

Evidence from other sports also supports the effectiveness of plyometric training. In futsal athletes, hurdle jumps and box jumps are reported to have an impact on sprinting and agility (Irawan et al., 2024). In women's soccer, plyometric training contributes to increased agility, jump, and repeated sprint performance (Maciejczyk et al., 2021). In women's handball, a comparison of strength and plyometric training showed that both can affect the ability to change of direction (Falch et al., 2022). Research on volleyball, badminton, taekwondo, tennis, and rhythmic gymnastics also shows that explosive training and neuromuscular training can increase lower limb stiffness, explosive power, balance, agility, and reactive strength index (Hu et al., 2025; Pavlovic et al., 2025; Shen, 2024; Zhou et al., 2025; Cabrejas et al., 2023). Thus, theoretical and empirical foundations support the use of plyometric training as a solution to improve physical performance components relevant to basketball.

While the literature evidence is quite strong, there are some gaps that need to be clarified. First, most previous studies have focused on the general effects of plyometric training on vertical jumps or sprints, while measurements combining vertical jump, standing broad jump, 20-meter sprint, and T-test agility in a single intervention in women's basketball athletes are still relatively limited. Second, some studies use a meta-analysis or systematic review design to provide an overview, but do not fully explain the effectiveness of training programs in the context of specific clubs with specific athlete characteristics (Cao et al., 2024; Zhao et al., 2025; Zhang et al., 2025). Third, the results of previous studies show that the plyometric effect is not always consistent across all performance indicators. For example, an increase in horizontal jumps may occur more strongly than an increase in sprint or agility, depending on the type of exercise and the sensitivity of the test instrument.

This gap is important because an effective training program needs to be proven through empirical data according to the characteristics of athletes. Several alternative training approaches such as complex training, French contrast method, resistance training, flywheel eccentric training, anaerobic power bicycle training, and integrative neuromuscular training have also shown benefits on lower limb performance and explosive abilities (Huang et al., 2025; Peng et al., 2025; Ding et al., 2025; Jiang et al., 2026; Kong et al., 2026). However, the method is not always easy to apply to clubs with limited facilities. Plyometric training is relatively more practical because it can be done with simple tools, a wide variety of movements, and is easily integrated into basketball training programs. Therefore, research testing an eight-week plyometric program in women's basketball athletes became relevant to provide applicative evidence for coaches.

This study aims to analyze the effect of the eight-week plyometric training program on increasing explosive power and supporting physical abilities in Redjay Bekasi women's basketball athletes. Specifically, this study examines performance changes through four indicators, namely Vertical Jump Test, Standing Broad Jump, 20 Meter Sprint, and T-Test Agility. The four indicators were chosen because they represent vertical jump ability, horizontal explosiveness, acceleration speed, and agility relevant to the needs of movement in a basketball game. The novelty of this study lies in the application of a structured plyometric training program for female basketball athletes aged 15–20 years in the context of clubs, with a duration of eight weeks, a frequency of three sessions per week, and a total of 24 training sessions. In addition, this study not only assesses one aspect of performance, but tests several interrelated physical components so that it can provide a more comprehensive picture of athletes' adaptation to plyometric training. The scope of the study was limited to the effect of exercise on explosive power, sprint, and agility, without examining aspects of game technique, psychology, nutrition, or advanced physiological variables.

METHODS

Research Design

This study uses a quantitative approach with a pseudo-experimental design in the form of a one-group pretest-posttest design. This design was chosen because the study aims to determine changes in athletes' physical performance before and after being given the plyometric training program. In this design, the entire subject follows the initial measurement, undergoes a training program over a certain period, and then follows the final measurement with the same instrument. The pretest-posttest approach is relevant in sports intervention research because it can describe changes in performance due to a given exercise program, especially in the variables of jump, speed, and agility ability. A few international studies on plyometric training have also used an interventional approach to assess changes in athletes' neuromuscular performance, vertical jump, sprint, change of direction, and physical fitness after a structured training program (Xie et al., 2024; Cao et al., 2024; Lin et al., 2025; Zhang et al., 2025).

Participants

The subjects of the study were 18 Redjay Bekasi women's basketball athletes aged 15–20 years. All athletes are active members of the club and participate in regular training programs. The selection of subjects was made based on the criteria of active involvement in basketball practice, willingness to participate in the entire series of interventions, as well as the physical conditions that make it possible to participate in plyometric exercises. Athletes who suffered injuries or were unable to consistently follow an exercise program were not included in the analysis. The characteristics of these participants are relevant to the focus of the research because female basketball athletes need leg power, acceleration ability, and agility to support game performance. Previous studies have shown that physical exercise in female athletes needs to consider the characteristics of age, training status, initial ability, and the needs of the sport so that exercise adaptation can take place optimally (Sánchez-Sixto et al., 2021; Sylvester et al., 2024; Lin et al., 2025).

Intervention Procedure

The intervention program in the form of plyometric training was carried out for eight weeks with a frequency of three sessions per week, so that the total training provided amounted to 24 sessions. Each training session is carried out in a structured manner and begins with warm-ups, followed by plyometric core exercises, then cooling. Plyometric exercises are geared towards stimulating the ability of leg muscles to generate explosive force through jumping, landing, pushing, and fast-moving motion patterns. The main principle of exercise refers to the stretch-shortening cycle mechanism, which is the ability of muscles and tendons to quickly utilize eccentric phases before producing explosive concentric contractions.

During the intervention, the trainer supervises the implementation of movement techniques, the quality of the landing, the readiness of the athletes, and the regularity of participating in the exercises. Such supervision is important because plyometric exercises demand neuromuscular coordination, postural control, and the ability to absorb weights on landing. The literature shows that the effectiveness of plyometric training is strongly influenced by the duration, frequency, volume, type of exercise, intensity, rest interval, and suitability of the form of exercise with the measured performance indicators (Chen et al., 2023; Deng et al., 2023; Cao et al., 2024; Zhao et al., 2025). Therefore, an eight-week program with three sessions per week was chosen to provide ample exercise stimulus while still considering the safety and recovery of athletes.

Instruments

Physical performance measurements were carried out using four instruments. First, the Vertical Jump Test is used to measure the vertical explosive power of the leg. This test is relevant to basketball movements such as rebounds, lay-ups, blocks, and jump shots. Second, Standing Broad Jump is used to measure horizontal explosive power, which is the ability to generate thrust of the limb in the forward direction. Third, the 20 Meter Sprint is used to assess acceleration ability and short-range speed. Fourth, the T-Test Agility is used to measure agility ability, change of direction, movement coordination, and body control. The four instruments were chosen because they represent the dominant physical performance component in basketball. Previous studies have shown that basketball performance is closely related to lower-limb power, sprinting, change of direction, and neuromuscular control. The use of jump, sprint, and agility tests is also widely found in plyometric training research because these instruments can describe the transfer of exercise adaptation to sports performance (Brini et al., 2023; Maciejczyk et al., 2021; Falch et al., 2022; Irawan et al., 2024; Goniotaki et al., 2026).

Data Collection Procedure

Data was collected through two stages, namely pretest and posttest. The pretest is conducted before the plyometric training program begins to get an idea of the athlete's initial abilities. After that, all participants participated in an eight-week training program. Posttest is carried out after the entire series of exercises is completed using the same procedures and instruments as the pretest. The similarity of procedures between pretest and posttest aims to maintain measurement consistency and reduce potential bias due to differences in test conditions. Before the measurement, the athlete is given instructions regarding the procedure of each test. Athletes also warm up so that the body is ready to perform explosive activities and reduce the risk of injury. Each test result is recorded as research data to be analyzed descriptively and inferentially. In sports intervention research, the consistency of measurement procedures is an important aspect because the observed changes in performance must reflect the impact of training, not technical differences during data collection (Xie et al., 2024; Zhang et al., 2025).

Data Analysis

Data were analyzed using descriptive and inferential statistics. Descriptive statistics are used to present the values of the number of samples, averages, standard deviations, standard errors, minimum values, and maximum values for each pretest and posttest variable. This analysis aims to provide an overview of changes in athlete performance after participating in the plyometric training program. Inferential analysis was carried out to determine the significance of the difference between pretest and posttest results. The ANOVA test is used to see the difference between measurement conditions on each variable. In addition, paired sample t-tests are used to test the difference in the average of pretest and posttest in pairs because the data comes from the same subject. The significance level was set at $p < 0.05$. If the significance value is less than 0.05, then the change is considered statistically significant.

In addition to statistical significance, this study also used effect size to assess the practical meaning of performance changes. The effect size in ANOVA is interpreted via eta-squared, while the paired sample effect size is interpreted through Cohen's d and Hedges' correction. Effect size analysis is important in exercise research because statistically significant results do not necessarily show a large practical impact, and conversely insignificant changes can still provide information about the direction of exercise adaptation. Recent studies confirm that effect size reporting is needed to clarify the power of exercise interventions on athlete performance, especially in studies with limited sample sizes (Cao et al., 2024; Lin et al., 2025; Zhao et al., 2025). Thus, a combination of descriptive analysis, differential tests, and effect size was used to provide a more comprehensive interpretation of the influence of plyometric training on the physical performance of women's basketball athletes.

RESULTS

This study involved 18 Redjay Bekasi women's basketball athletes aged 15–20 years who participated in a plyometric training program for eight weeks with a frequency of three sessions per week or a total of 24 training sessions. The measurement was carried out through four physical performance indicators, namely Vertical Jump Test, Standing Broad Jump, 20 Meter Sprint, and T-Test Agility. The four indicators are used to assess vertical explosive power, horizontal explosive power, acceleration speed, and agility.

Table 1. Descriptive statistic

		N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Vertical Jump	Pretest	18	311.67	153.970	36.291	32	445
	Postest	18	374.33	123.268	29.054	43	484
	Total	36	343.00	141.085	23.514	32	484
Standing Broad Jump	Pretest	18	171.78	11.399	2.687	158	197
	Postest	18	183.22	11.538	2.720	165	205
	Total	36	177.50	12.707	2.118	158	205
Sprint 20 Meter	Pretest	18	343.00	112.375	26.487	35	404
	Postest	18	327.33	106.465	25.094	37	386
	Total	36	335.17	108.177	18.030	35	404
Ttest Agility	Pretest	18	1001.44	442.182	104.223	12	1265
	Postest	18	1075.72	270.778	63.823	12	1207
	Total	36	1038.58	363.319	60.553	12	1265

Descriptively, the results of the study show an increase in the explosive power component of the limb. The average Vertical Jump increased from 311.67 in the pretest to 374.33 in the posttest, while the Standing Broad Jump increased from 171.78 to 183.22. In the 20-Meter Sprint, the average value decreased from 343.00 to 327.33, which could indicate an improvement in travel time. However, in the T-Test Agility, the average score increased from 1001.44 to 1075.72, so if the score is expressed as time, this result indicates that agility performance has not improved after the intervention. In general, the most consistent changes are seen in the ability to jump, especially the Standing Broad Jump. These findings are consistent with the characteristics of plyometric training that stimulates stretch-shortening cycles, neuromuscular reactivity, and the ability to generate explosive forces in a short period of time (Xie et al., 2024; Cao et al., 2024; Zhao et al., 2025; Zhang et al., 2025).

Table 2. Anova test result

		Sum of Squares	df	Mean Square	F	Sig.
VerticalJump	Between Groups	35344.000	1	35344.000	1.817	.187
	Within Groups	661328.000	34	19450.824		
	Total	696672.000	35			
StandingBroadJump	Between Groups	1178.778	1	1178.778	8.962	.005
	Within Groups	4472.222	34	131.536		
	Total	5651.000	35			
Sprint20Meter	Between Groups	2209.000	1	2209.000	.184	.670
	Within Groups	407372.000	34	11981.529		
	Total	409581.000	35			

TtestAgility	Between Groups	49654.694	1	49654.694	.369	.547
	Within Groups	4570378.056	34	134422.884		
	Total	4620032.750	35			

The results of the ANOVA test showed that only the Standing Broad Jump experienced significant differences between the pretest and posttest, with values of F = 8.962 and p = 0.005. In contrast, Vertical Jump showed no significant difference despite the average increase, with F = 1.817 and p = 0.187. The 20 Meter Sprint was also insignificant, with F = 0.184 and p = 0.670, as was the T-Test Agility with F = 0.369 and p = 0.547. These results show that exercise adaptation does not occur evenly across all components of physical performance.

Table 3. Anova effect size test result

		Point Estimate	95% Confidence Interval	
			Lower	Upper
Vertical Jump	Eta-squared	.051	.000	.235
	Epsilon-squared	.023	-.029	.212
	Omega-squared Fixed-effect	.022	-.029	.208
	Omega-squared Random-effect	.022	-.029	.208
Standing Broad Jump	Eta-squared	.209	.021	.415
	Epsilon-squared	.185	-.007	.398
	Omega-squared Fixed-effect	.181	-.007	.392
	Omega-squared Random-effect	.181	-.007	.392
Sprint 20 Meter	Eta-squared	.005	.000	.132
	Epsilon-squared	-.024	-.029	.107
	Omega-squared Fixed-effect	-.023	-.029	.104
	Omega-squared Random-effect	-.023	-.029	.104
Ttest Agility	Eta-squared	.011	.000	.153
	Epsilon-squared	-.018	-.029	.129
	Omega-squared Fixed-effect	-.018	-.029	.125
	Omega-squared Random-effect	-.018	-.029	.125

a. Eta-squared and Epsilon-squared are estimated based on the fixed-effect model.
b. Negative but less biased estimates are retained, not rounded to zero.

The Standing Broad Jump has an eta-squared value of 0.209, which suggests that about 20.9% of the variation in performance changes can be explained by the plyometric training program. This value indicates a practically meaningful effect. Meanwhile, Vertical Jump has an eta-squared of 0.051, a 20-meter Sprint of 0.005, and a T-Test Agility of 0.011. Thus, the main influence of the intervention is on horizontal explosiveness, while the effect on vertical explosivepower, sprint, and agility is still limited. This pattern demonstrates the importance of the principle of exercise specificity, as plyometric adaptation transfer is strongly influenced by the suitability of the direction of motion, the type of stimulus, and the characteristics of the test used (Chen et al., 2023; Deng et al., 2023; Lin et al., 2025).

Table 4. Paired sample test result

	Paired Differences						
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	t	df	Sig. (2-tailed)

					Lower	Upper			
Pair 1	Vertical Jump pre – Vertical Jump post	-62.667	210.916	49.713	-167.553	42.219	-1.261	17	.224
Pair 2	Standing Broad Jump pre – Standing Broad Jump post	-11.444	3.276	.772	-13.074	-9.815	-14.821	17	.000
Pair 3	Sprint 20 Meter pre – Sprint 20 Meter post	15.667	161.090	37.969	-64.442	95.775	.413	17	.685
Pair 4	Ttest Agility pre – Ttest Agility post	-74.278	544.755	128.400	-345.178	196.622	-.578	17	.571

The results of the paired sample t-test showed that a significant increase occurred only in the Standing Broad Jump. The average difference between the pretest-posttest and the pretest was -11,444 with t = -14,821 and p = 0,000 indicating that the posttest score was significantly higher than the pretest. Cohen's d value of -3.493 and Hedges' correction of -3.416 show a very strong effect in practice. Negative signs occur because the calculation uses the pretest difference minus the posttest, so it does not show a decrease in performance, but an increase in posttest results. Thus, the change in Standing Broad Jump is not only statistically significant but also has great practical significance in the context of increasing the horizontal explosive power of athletes.

In the Vertical Jump, the mean difference of -62,667 with t = -1,261 and p = 0.224 indicates that the increase has not been statistically significant. Cohen's value of d of -0.297 and Hedges' correction of -0.291 indicate a small effect. This means that even if there is an average increase from pretest to posttest, the magnitude of the change is not strong enough to show a convincing practical impact. These results show that the plyometric training program provided has not optimally stimulated vertical explosive adaptation.

In the 20 Meter Sprint, the mean difference of 15,667 with t = 0.413 and p = 0.685 showed that the change in sprint time was not significant. Cohen's value d of 0.097 and Hedges' correction of 0.095 showed very small effects. This interpretation indicates that plyometric training interventions have not made a meaningful practical contribution to the increase in sprint speed of 20 meters. Thus, despite the tendency to change descriptively, the effect of exercise on sprints is still very limited.

In the T-Test Agility, the mean difference of -74.278 with t = -0.578 and p = 0.571 also showed a non-significant change. Cohen's d value of -0.136 and Hedges' correction of -0.133 indicate a small effect. These results mean that the training program has not had a strong practical impact on agility ability. Agility is a complex ability that depends not only on the explosiveness of the legs, but also on the ability to decelerate, postural control, coordination of changes of direction, and the response of motion to the stimulus of the game.

Table 5. Paired sample effect size

					95% Confidence Interval	
			Standardizer[a]	Point Estimate	Lower	Upper
Pair 1	VerticalJumppre - VerticalJumpost	Cohen's d	210.916	-.297	-.765	.180
		Hedges' correction	215.716	-.291	-.748	.176
Pair 2	StandingBroadJumppre - StandingBroadJumpost	Cohen's d	3.276	-3.493	-4.738	-2.234
		Hedges' correction	3.351	-3.416	-4.632	-2.185
Pair 3	Sprint20Meterpre - Sprint20Meterpost	Cohen's d	161.090	.097	-.367	.559
		Hedges' correction	164.756	.095	-.359	.547
Pair 4	TtestAgilitypre - TtestAgilitypost	Cohen's d	544.755	-.136	-.599	.330
		Hedges' correction	557.151	-.133	-.585	.322

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

The results of the paired sample effect size made it clear that the greatest effect of training was found in the Standing Broad Jump, while the Vertical Jump, 20 Meter Sprint, and T-Test Agility showed only small or very small effects. These findings confirm that the plyometric training program in this study is more effective in increasing horizontal explosiveness than vertical jump, sprint, and agility capabilities. The interpretation of effect size is important in scientific publications because it helps explain the practical meaning of an intervention, especially when some variables do not show statistical significance but still undergo changes in the mean (Sánchez-Sixto et al., 2021; Chen et al., 2023; Xie et al., 2024; Zhao et al., 2025).

Overall, the eight-week plyometric training program was effective in improving the Standing Broad Jump, but it did not have a significant effect on the Vertical Jump, 20 Meter Sprint, and T-Test Agility. The increase in Standing Broad Jump can be explained through neuromuscular adaptation, increased elastic energy utilization, motor unit recruitment, and more efficient eccentric-concentric phase coordination. This mechanism is the main basis for increasing explosive power through plyometric exercises (Sánchez-Sixto et al., 2021; Cherni et al., 2021; Wang et al., 2022; Xie et al., 2024).

The insignificant changes in Vertical Jump, 20 Meter Sprint, and T-Test Agility show that the increase in leg power does not always immediately transfer to all physical performance components. Vertical Jump requires a more specific stimulus to the direction of vertical force, while sprint and agility require a combination of acceleration, step frequency, deceleration, change of direction, postural control, and engineering efficiency. Therefore, improving sprint and agility typically requires plyometric integration with sprint drills, resisted sprints, multidirectional movement, deceleration training, and change-of-direction drills (Pardos-Mainer et al., 2021; Brini et al., 2023; Maciejczyk et al., 2021; Falch et al., 2022; Irawan et al., 2024).

These findings provide practical implications that plyometric training can be recommended as a training method to increase the horizontal explosiveness of women's basketball athletes. However, if the goal of the exercise is to improve performance more thoroughly, the program needs to be modified more specifically and progressively. To improve vertical jumping ability, exercises can include variations of vertical jump, countermovement jump, drop jump, and depth jump. To improve sprint and agility, training needs to be combined with acceleration, reaction, change of direction, and multidirectional movement patterns that resemble basketball game situations. Thus, the results of this study support the literature that the effectiveness of plyometric training is highly dependent on the suitability between the form of training, test indicators, and the performance needs of the sport.

DISCUSSION

The study's key findings suggest that an eight-week plyometric training program exerts the most significant influence on the increase in horizontal explosiveness of female basketball athletes, while changes in vertical explosiveness, short-distance sprints and agility have not shown the same strong response. Rationally, this pattern can be understood through the principle of exercise specificity. Performance adaptation tends to be greater when the exercise movement pattern has similarities with the test movement pattern used. If the training stimulus is more predominantly involved forward pushing, horizontal jumping, or anterior-oriented explosive movements, then adaptive transfer is more easily seen in horizontal power capabilities than in vertical performance, linear sprints, or changes of direction.

In the context of basketball, the explosiveness of the legs is an important component because it supports the ability to accelerate, rebound, lay-up, jump stop, defensive shuffle, and change of direction. However, each of these performance components has different biomechanical demands. Horizontal jumps emphasize the production of forward forces, while vertical jumps require a more dominant vertical force orientation. Sprints demand coordination of steps, frequency, step length, and the ability to apply horizontal force repeatedly. Agility is even more complex because it involves acceleration, deceleration, change of direction, dynamic balance, and postural control. Therefore, not all automatic limb power increases result in equal improvements in sprint and agility. This view is in line with the literature that asserts that the effects of plyometric training are strongly influenced by the direction of motion, exercise characteristics, athlete status, age, gender, frequency, volume, and duration of intervention (Xie et al., 2024; Cao et al., 2024; Lin et al., 2025; Zhao et al., 2025; Zhang et al., 2025).

The results of this study support a few previous studies that stated that plyometric training is effective in increasing the explosive abilities of the limbs. Xie et al. (2024) report that plyometric training has the potential to improve vertical jumping and sprinting abilities in sports individuals, while Chen et al. (2023) assert that plyometric training contributes to an increase in lower limb explosive strength in adolescent athletes. In the context of female athletes, Lin et al. (2025) and Zhao et al. (2025) showed that plyometric training can improve jump, sprint, and change-of-direction performance, although the magnitude of the effect is influenced by program characteristics and participant profiles. The findings of this study are also consistent with Cherni et al. (2021), who found neuromuscular adaptation and improved physical performance in female basketball athletes after an eight-week plyometric training program.

However, the results of this study also show a difference with some of the previous findings. Sánchez-Sixto et al. (2021) showed that plyometric and combined plyometric training can affect the biomechanics of vertical jump in female basketball athletes, while in this study increased vertical explosiveness has not been the most dominant response. This difference can be due to variations in training design, intensity, type of jump, weight progressivity, technique quality, and athlete's initial ability. In addition, Figueira et al. (2025) emphasized that the frequency of weekly training during the competition season can affect the performance response of women's basketball athletes, so differences in the number of sessions, recovery time, and training context may also determine the outcome.

In terms of sprint and agility, the results of this study showed a more limited effect than some other studies. Maciejczyk et al. (2021) found that short-term plyometric training can improve agility, jump, and repeated sprint performance in female soccer players. Irawan et al. (2024) also reported the impact of plyometric training on sprint and agility in futsal athletes, while Falch et al. (2022) showed that strength and plyometric training can affect change-of-direction performance in young women's handball. This contradiction can be explained by differences in the characteristics of the sport, the pattern of exercise movement, the form of the test, and the degree of specificity of the stimulus. Sprint and agility require more targeted training on acceleration, deceleration, reaction, and change of direction, so plyometrics alone are not necessarily enough to produce significant improvements in these two components (Brini et al., 2023; Pardos-Mainer et al., 2021; Feng et al., 2026; Zhou et al., 2025).

Theoretically, plyometric training works through the optimization of the stretch-shortening cycle, which is the ability of muscles and tendons to store elastic energy in the eccentric phase, then release it quickly in the concentric phase. This process improves neuromuscular efficiency, motor unit recruitment, rate of force development, intermuscular coordination, and landing control. This adaptation is the basis for increasing explosive power, especially when training is carried out progressively and in accordance with the measured performance demands (Wang et al., 2022; Xie et al., 2024; Deng et al., 2023; Montoro-Bombú et al., 2023).

A developmental interpretation of these findings suggests that the training program provided has been sufficiently effective in stimulating horizontal power adaptation but has not been specific enough to produce optimal transfers in vertical power, sprint, and agility. In exercise transfer theory, performance improvement occurs when there is a match between the structure of the exercise's motion, the direction of force, the speed of contraction, and the demands of task coordination. Therefore, standing broad jumps are more responsive because they have a biomechanical proximity to the horizontal thrust pattern that is likely to be dominant in training. In contrast, vertical jump requires vertical force orientation, while sprint and agility require integration of power, step technique, trunk stability, braking ability, and re-acceleration.

These findings can also be understood through a neuromuscular specificity approach. Exercises that focus solely on explosive jumps are not necessarily enough to improve the ability to change direction because agility involves the perceptual-motor components and postural control. Brini et al. (2023) show that basketball exercises that combine drop jumps and multidirectional repeated sprints can result in more specific neuromuscular adaptation and balance. Future program development may consider a combination of plyometrics with balance training, resisted sprint, multidirectional movement, complex training, or flywheel eccentric training as the combined approach is reported to be more supportive of explosive performance enhancement and change of direction (Feng et al., 2026; Peng et al., 2025; Huang et al., 2025; Sun et al., 2025; Kong et al., 2026).

Practically, the results of this study provide recommendations that plyometric training can be used as a training method to increase the horizontal explosiveness of women's basketball athletes. Trainers can include variations of exercises such as broad jump, bounding, squat jump, hurdle jump, lateral jump, and jump-to-stabilization while keeping in mind the quality of technique, landing control, rest interval, and weight progressivity. The training program also needs to be adjusted to age, training experience, physical condition, and periodization phase so that the stimulus provided is safe and effective for female athletes (Cao et al., 2024; Sylvester et al., 2024; You et al., 2026; Figueira et al., 2025).

If the target of the exercise is an increase in vertical jump, then the program needs to increase stimuli that emphasize the orientation of vertical forces, such as countermovement jump, drop jump, depth jump, and approach jump. If the target is sprint and agility, then plyometric training needs to be combined with sprint drills, acceleration drills, deceleration drills, change-of-direction drills, reactive agility, and multidirectional exercises that resemble match situations. This approach is important because basketball performance is not only determined by leg power, but also by the ability to move quickly, stop, change direction, maintain balance, and make decisions under the pressure of the game (Goniotaki et al., 2026; Yılmaz et al., 2025; Zhang et al., 2025; Li et al., 2025). In addition, training integration needs to consider neuromuscular profile, balance, training load, post-activation performance enhancement response, fatigue, and basketball performance characteristics as these factors affect the transfer of training to game skills (Elnaggar et al., 2022; Feng et al., 2026; Gál-Pottyondy et al., 2025; Lyu et al., 2025; Qi et al., 2025; Qu et al., 2026; Si et al., 2026; Wan et al., 2025; Wang et al., 2025).

Thus, the results of this study not only strengthen the evidence that plyometric training is beneficial for the development of explosive power but also confirm the need for more specific training design for performance goals. Stand-alone plyometric programs can be the foundation of power enhancement, but to produce more well-rounded basketball performance, coaches need to integrate it with strength, balance, sprint, agility, and technical skill training. This implication is in line with the direction of recent research that places basketball physical training as a multidimensional process, rather than just an improvement of one biomotor component separately (Sacot et al., 2022; Liu et al., 2025; Zhang et al., 2025; Gál-Pottyondy et al., 2025).

CONCLUSION

Based on the results of the study, it can be concluded that the eight-week plyometric training program has a positive influence on increasing the explosive power of Redjay Bekasi women's basketball athletes, especially in the horizontal explosive power component measured through Standing Broad Jump. These findings suggest that plyometric exercises are effectively used to improve the ability of the legs to generate explosive thrust in the horizontal direction, which is relevant to the needs of motion in basketball games such as initial acceleration, repulsion, offensive transitions, and explosive movements on the court. However, the effect of the exercise program does not occur evenly on all physical performance variables. The improvements in Vertical Jump, 20 Meter Sprint, and T-Test Agility have not shown significant changes. Thus, the research hypothesis is partially accepted. The plyometric training in this study has been shown to be effective in increasing horizontal explosiveness, but it is not strong enough to significantly increase vertical explosiveness, sprint speed, and agility. These results confirm the importance of the principle of training specificity in the preparation of physical condition programs for women's basketball athletes. If the goal of the exercise is to improve vertical jumping ability, then the program needs to include more vertical-style variations of exercises such as countermovement jump, drop jump, depth jump, and approach jump. If the goal of training is to improve sprint and agility, then plyometric training needs to be combined with acceleration, deceleration, change of direction, reaction, and multidirectional movement exercises that resemble basketball situations. Practically, trainers can use plyometric training as part of an explosive power enhancement program, but it is necessary to integrate it with other physical exercises to make performance adaptation more comprehensive. Further research is suggested using larger sample sizes, control groups, variations in exercise intensity, and more specific measurements of basketball technique so that the effectiveness of the program can be analyzed more comprehensively.

RECOMMENDATION

Based on the results of the study, coaches are advised to use plyometric training as one of the training methods to increase the explosive power of women's basketball athletes' legs, especially horizontal explosive ability. Exercise programs can include variations of movements such as broad jump, bounding, squat jump, hurdle jump, lateral jump, and jump-to-stabilization. Training needs to be carried out in stages by paying attention to the athlete's readiness, technique quality, landing control, intensity, volume, rest interval, and the principle of progressivity so that the adaptation of the exercise takes place optimally and the risk of injury can be minimized. To improve more overall performance, plyometric training should not stand alone. Coaches need to combine it with strength training, acceleration, deceleration, change of direction, reactive agility, and multidirectional movement patterns that match the characteristics of the basketball game. If the goal of the exercise is directed at increasing vertical jumps, then the program needs to add variations of countermovement jumps, drop jumps, depth jumps, and approach jumps. If the goal of the training is to improve sprint and agility, then the training should be more specific on step speed, directional change technique, dynamic balance, and the ability to stop and move back quickly. For athletes, it is recommended to follow a consistent exercise program, maintain movement techniques, warm up and cool down well, and pay attention to the body's recovery after training. For subsequent researchers, it is recommended to use a control group, a larger sample count, a longer duration of exercise, and a more specific variety of programs. Future research can also examine the effect of plyometric training on basketball technical skills, injury risk, body composition, muscle strength, and match performance so that the benefits of training can be understood more comprehensively.

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