

A comparison of the effects of plyometric training and ladder drills on the agility of basketball players

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Abstract

Optimal physical development supports match performance and training. However, training programs designed for physical development are often ineffective. Therefore, this study aims to determine the effectiveness of plyometric training and ladder drills on the agility of basketball players and to compare the effects of these two training methods on agility.

This study was a quantitative study with an experimental design. The study population consisted of 20 basketball players from Bone Regency. The sampling technique used was total sampling. The research instrument was the Arrowhead Agility Test. Data analysis used paired t-tests and independent t-tests.

The results of the data normality test showed a significance value greater than 0.05, indicating that the data were normally distributed. Both plyometric training and ladder drills significantly improved the agility of basketball athletes, and there were differences between the two training methods.

The research findings indicate that both plyometric training and ladder drills significantly improved the agility performance of basketball athletes. Both methods are equally effective in improving agility. These results highlight that plyometric exercises and ladder drills can be used to improve anaerobic endurance performance.

Keywords: exercise, plyometric, ladder drill, agility, basketball

INTRODUCTION

Basketball is a highly dynamic sport that requires movement across various areas of the court as well as rapid transitions. Basketball is characterized by high speed, explosive power, and good coordination, which not only demands that athletes possess teamwork skills and good tactical ability, but also strong explosive power, as well as good coordination and flexibility (Chen et al., 2018, p. 140). In a basketball match, athletes will frequently face physical contact with other players or opponents, so they require good physical condition. The physical fitness required of a basketball player includes endurance, strength, speed, agility, coordination, and flexibility (Hardopo Putro et al., 2023; Pradana et al., 2020, p. 1).

Given the intensive nature of basketball, which demands consistent performance throughout the match, basketball players need to possess good physiological capacity as well as technical skills to cope with the demands of competitive matches (Mayangsari et al., 2024; Panagiotis et al., 2021, p. 948). A variety of effective training exercises is required to maintain the physical readiness of basketball athletes. Various studies have been conducted on training methods to improve athletes' physical abilities

(Anversha et al., 2024, p. 638; Fansuri & Situmeang, 2021, p. 116). These studies help provide innovative solutions for training athletes. Exercises such as plyometrics and ladder drills are frequently used as alternatives to improve basketball players' agility. A player with good agility possesses several advantages, including the ability to perform difficult movements with ease, a reduced risk of falling or sustaining injuries, and support for their playing technique. The ability to move, change direction, and adjust position in accordance with the situation and conditions faced within a relatively short and rapid timeframe (Pradana et al., 2020, p.1).

Agility is a performance quality that directly contributes to success in sports where athletes must change direction and speed rapidly (Sekulic et al., 2017, p. 2278). One of the key factors in basketball is agility. Generally speaking, agility encompasses: (a) The ability to change direction rapidly based on prior knowledge of that change of direction (i.e., planned agility, non-reactive agility, closed-skill agility, speed of change of direction) and (b) the ability to change direction rapidly whilst responding to unexpected visual or auditory stimuli (i.e., unplanned agility, reactive agility, open-skill agility) (Sekulic et al., 2017, p. 2278). Rapid changes of direction in basketball can help players minimize disruption from opponents and gain an advantage both technically and tactically (Wang et al., 2024, p. 2). Agility is a key reflection of various aspects such as physical strength, speed, flexibility, and balance, which serve as a vital physical foundation for basketball players to perform a series of high-level technical movements on the court.

Computerized agility training, plyometric exercises, and ladder drills are forms of agility training that focus on quick and precise changes of direction performed in a back-and-forth manner. In basketball, players are required to change direction quickly, stop suddenly, and engage in physical contact with other players. In basketball, there are two main training methods used: ladder drills, which focus on rhythm and coordination through pre-determined patterns, and Computerized Agility Training (CAT), which combines random visual stimuli and reactive tasks (Wang et al., 2024, p. 2). The ladder drill involves using a fitness ladder, where athletes run, jump, and leap with rapid footwork through the ladder, thereby helping to develop agility and speed (Fatchurrahman et al., 2019, p. 156). The ladder drill is an exercise designed to improve agility through various footwork variations using a ladder-shaped apparatus. The ladder drill is an exercise featuring movement variations such as in-out, lateral, and hop, designed to improve an athlete's agility (Putu et al., 2021, p. 99). The ladder drill is a form of training aimed at enhancing an athlete's agility to achieve peak performance.

Plyometric exercises are effective for increasing tendon stiffness, improving jumping performance, and enhancing lower-body strength (Rajan et al., 2018, p. 1297). Plyometric training is a popular method for improving strength, explosive power, speed, and agility (Asadi et al., 2017, p. 2610). These exercises typically involve rapid, forceful movements that utilize the stretch-shortening cycle. The stretch-shortening cycle involves the storage of elastic energy during the initial stretch, which contributes to increased force during the subsequent muscle shortening. An athlete's ability to utilize the stretch-shortening cycle can have a positive impact on speed, strength, jumping ability, and agility (Asadi et al., 2017, p. 2610). Plyometric training is a highly popular form of physical conditioning for healthy individuals and has been extensively studied over the past few decades (Slimani et al., 2016). Plyometric training is a form of exercise that can be used to improve an athlete's biomotor fitness, including strength and speed, and has very wide-ranging applications in sporting activities (Arafat et al., 2018, p. 250). Plyometric training is a training method that emphasizes explosive muscle contraction through the stretch-shortening cycle (SSC) mechanism.

Efforts to improve basketball players' agility through appropriate training programs are essential. Various training programs can be implemented to enhance basketball players' agility, such as ladder drills. Ladder drills are an important part of many sports training programs, requiring athletes to move their feet quickly in precise, controlled movements (Pradana et al., 2020, p. 2). Plyometric exercises are also a key component of training programs designed to improve agility. The term 'plyometric' derives from the Greek word meaning 'to increase' or from the word 'plyo', which refers to exercises that enable muscles to achieve maximum strength in the shortest possible time (Rajan et al., 2018, p. 1296). Ladder drills and plyometric exercises can be used to improve agility, balance, coordination, and speed. This study aims to determine the comparative effectiveness of plyometric exercises and ladder drills in improving the agility of basketball players.

METHOD

Participants

A total of twenty basketball players (aged 17–18) took part in this study, which was conducted in Bone, Indonesia. All players were members of the Bone Regency men’s basketball team. The players were divided into two groups: the plyometric training group (n=10) and the ladder drill training group (n=10). All players were provided with an explanation and instructions regarding the procedures, requirements, benefits, and risks of the study.

Research Design

This study employed a pre-experimental design, specifically a two-group pretest-posttest design. In the initial phase, the players underwent a pretest before receiving any treatment or intervention. Following this, the players undertook a plyometric training program for group one and a ladder drill training program for group two to improve agility. In the final stage, the players underwent a posttest. The pretest and posttest results for each group were then calculated to determine the improvement before and after the plyometric and ladder drill training programs. After comparing the pretest and posttest results within each group, a comparison was made between Group One and Group Two. Data were collected using valid and specific instruments. Agility was assessed using the Arrowhead Agility Test. The Arrowhead Agility Test instrument has a validity of 0.831 and a reliability of 0.981 (Lockie & Jalilvand, 2017).

Protocol Design

The training program for each group was conducted four times a week over a four-week training period. Each training session began with a warm-up phase, followed by the implementation of the plyometric and ladder drill training programs according to group allocation, and concluded with a cool-down phase. This program was consistently applied throughout the study period. Table 1 shows the implementation of the plyometric training phase in this program, and Table 2 shows the implementation of the ladder drill training phase. In group one (plyometric training), the rest periods between repetitions and between sets were the same each week, whilst the number of sets and repetitions varied each week. For group two (ladder drill training), the rest periods between repetitions and between sets were the same each week, whilst the number of sets and repetitions also varied each week.

Statistical Analysis

Statistical data analysis in this study utilized the Shapiro-Wilk test to assess data normality. Differences in pretest and posttest results within each group were compared using a paired-sample t-test. The statistical significance level for this study was set at $p < 0.05$. Furthermore, an independent t-test was conducted to compare the effects of the training between Group One (plyometric training) and Group Two (ladder drill training). Statistical data analysis was performed using SPSS version 25.0 for Windows.

RESULTS AND DISCUSSION

The comparison of the plyometric training programme and the ladder drill was analysed using an independent samples t-test and a paired samples t-test to assess the effectiveness of the plyometric training and the ladder drill.

Table 1. Plyometric Training Programme

Week	Session	Description Exercise	Sets	Repetitions	Interval (Per Repetition)	Interval (Per Set)
1	1 – 4	The players perform four exercises, namely: 1. Front Cone Hops 2. Lateral Cone Barrier Jumps 3. Vertical Jump 4. Jump and Reach	1	6	30s	60s

2	5 - 8	The players perform four exercises, namely: 1. Lateral Cone Barrier Jumps 2. Jump and Reach 3. Lateral Barrier Jumps 4. Vertical Jump	2	5	30s	60s
3	9 – 12	The players perform four exercises, namely: 1. Lateral Cone Barrier Jumps 2. Lateral Barrier Jumps 3. Cone Forward Run to Back Pedal 4. Standing Jumps Cone Hops with 180 Degree Turn	2	5	30s	60s
4	12 - 16	The players perform four exercises, namely: 1. Lateral Cone Barrier Jumps 2. Lateral Barrier Jumps 3. Cone Forward Run to Back Pedal 4. Single Leg Vertical Jump	4	3	30s	60s

Table 2. Ladder Drill Training Programme Table

Week	Session	Description Exercise	Sets	Repetitions	Interval (Per Repetition)	Interval (Per Set)
1	1 – 4	The players perform four exercises, namely: 1. Lateral Two in Two out 2. Two in the Hole 3. Two in Lateral 4. Lateral Two in Two out	1	6	30s	60s
2	5 - 8	The players perform four exercises, namely: 1. Lateral Two in Two out 2. Two in the Hole 3. Two in Lateral 4. Lateral Two in Two out	2	5	30s	60s
3	9 – 12	The players perform four exercises, namely: 1. One Latera; 2. Lateral Ickey Shuffle 3. Ickey Shuffle Backward	2	5	30s	60s

		4. Ickey Shuffle				
4	12 - 16	The players perform four exercises, namely: 1. One Latera 2. Lateral Ickey Shuffle 3. Ickey Shuffle Backward 4. Ickey Shuffle	4	3	30s	60s

Table 3. Results of the Normality Test

Group	Variable	N	Sig.
Pre Test	Ladder Drill	10	0.692
Pre Test	Plyometric	10	0.534
Post Test	Ladder Drill	10	0.631
Post Test	Plyometric	10	0.187

Note: The normality of the data was tested using the Shapiro-Wilk test; the data for the plyometric exercises and ladder drills were found to be normally distributed, with a significance level of >0.05.

Table 4. Results of the t-test

	Variable	Mean	Std. Deviation	Sig.
Pair 1	Pre- Test Ladder Drill	13.7170	0.61157	0.000
	Pos-Test Ladder Drill	11.9380	0.66821	
Pair 2	Pre-Test Plyometric	13.7460	0.50855	0.000
	Post-Test Plyometric	12.5230	0.51618	

Note: The results of the t-test comparing the pre-test and post-test for plyometric exercises showed a p-value of 0.000, whilst the results for ladder drills showed a p-value of 0.000; both p-values were <0.05, indicating a significant improvement.

Table 5. Results of the Independent t-test

Variable	Equality of Variances		T-test for Equality of Means			
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Agility	1.384	.255	-2.191	18	.042	-.58500

Note: The significance level of the independent samples t-test was <0.05. The results of the study indicate that there is a significant difference between plyometric training and ladder drill training, with a two-tailed significance level of 0.042.

Based on the significance values for plyometric training and ladder drill training, which were found to be less than 0.05, this indicates an improvement between the pre-test and post-test results. Furthermore, Table 5 compares the effectiveness of plyometric training and ladder drill training using an independent t-test; with significance values less than 0.05, this indicates that there is a significant difference between plyometric training and ladder drill training.

The primary objective of this study was to compare the effectiveness of plyometric exercises and ladder drills, as well as to examine the impact of plyometric exercises on basketball players. The uniqueness of this study lies in the modification of the duration, frequency, and variation of plyometric exercises and ladder drills, as well as the comparison of the effectiveness of these two training methods in improving the agility of basketball athletes.

The findings of this study support the first hypothesis, which indicates a significant improvement (sig. < 0.05) in agility performance (Table 4). This suggests that both plyometric training and ladder drill training successfully enhance agility. These findings are consistent with previous research, which showed that plyometric training and ladder drill training are suitable and beneficial for the physical training of basketball players (Slimani et al., 2016, p. 239) (Fansuri & Situmeang, 2021).

Furthermore, a comparison of the plyometric training method and the ladder drill training method revealed a significant difference ($p < 0.05$), indicating that there is a difference in effectiveness between the two methods in improving agility performance. Similar research also highlights that plyometric and ladder drill training methods differ in their ability to improve the agility performance of basketball players (Koba, 2024, p. 83). Ladder drill training is more effective than plyometric training. This study also found that both plyometric and ladder drill training have a significant effect on agility.

Specifically, this study was designed to test plyometric training versus ladder drill training on agility ability. The results of the study showed significant differences. Plyometric training is a method of exercise conducted to enhance an athlete's capabilities; it combines speed and strength (Rajan et al., 2018, p. 1297). Plyometric training aims to increase an athlete's muscular power, helping them run faster, jump further, or generate greater force at higher speeds. Plyometric training emerged and is derived from sports characterized by strength and speed (Adigüzel & Günay, 2016, p. 2). The ladder drill is a training method useful for improving foot speed, agility, coordination, and overall speed (Pradana et al., 2020, p. 3). The ladder drill is a form of exercise using equipment resembling a ladder, consisting of a rope laid on the floor, with athletes stepping on it with one or both feet. This exercise is beneficial in helping athletes achieve rapid movement through training methods suited to their abilities. The ladder drill assists athletes in various movements to train speed and agility with good foot coordination (Haryono et al., 2021, p. 480)

Plyometric training and ladder drills demonstrated improvements in agility following the respective interventions. Consequently, the findings of this study are expected to be valid and to provide valuable guidance for coaches and athletes, particularly in the field of basketball. A limitation of this study is the small sample size of male participants, which does not allow for more comprehensive findings regarding gender, level of competition, or different age groups. Further research is recommended to use a larger sample size and to apply plyometric and ladder drill training methods that take into account player profiles, including gender and competition level.

CONCLUSION

Based on the research findings, both plyometric exercises and ladder drills demonstrated significant results (sig. < 0.05), and a comparison of the effects of plyometric exercises and ladder drills also showed statistical significance (sig. < 0.05). This indicates that both training methods are equally effective in improving agility in basketball players, whilst there are also differences in the effects of these two training methods on enhancing players' agility. Therefore, these findings can be taken into account by coaches when developing training programs, as they can improve agility in basketball players. Furthermore, this study provides an important foundation for future research to encourage more comprehensive studies exploring various populations and genders.

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