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The Effect of Plyometric Training on the Change of Direction Ability of FIKK UNM Squash Players

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Abstract. This study aims to determine the effect of plyometric training on the ability to change of direction in squash players of the Faculty of Sports Sciences, State University of Makassar (FIKK UNM). The ability to change of direction is essential in a squash game that demands a quick response to balls coming from different directions. The study used a pre-test and post-test group design with a total of 20 subjects. Plyometric exercises are carried out for 6 weeks with a frequency of 3 times per week. Measurement of directional change ability is performed using the Illinois Agility Test. The results showed that there was a significant increase in the experimental group ($p < 0.001$) with an average time decrease of 1.42 seconds. Meanwhile, the control group showed a less significant increase with an average time decrease of 0.13 seconds. The results of the independent t-test also showed a significant difference between the experimental and control groups in the post-test ($p < 0.001$). It can be concluded that plyometric training has a significant influence on improving the ability to change of direction in squash players. This exercise is recommended as part of a regular exercise program to improve the performance of fast movements and changes in the direction of athletes.

Keywords: Plyometric Training, Change of Direction, Squash.

1 Introduction

The development of sports in the modern era requires an overall improvement in athlete performance, both from physical, technical, and mental aspects. One of the sports that demands high physical ability is squash. Squash is a game that requires speed, agility, endurance, and the ability to change direction quickly in a limited space (Iswoyo & Junaidi, 2015; Murray & Hughes, 2016). In this game, a player is required to respond to the arrival of the ball from various directions with explosive and fast movements, so that the ability to change of direction (COD) is one of the crucial aspects that affects the overall performance of the game (Schoeman et al., 2014). The speed of the player in changing direction is the key to success in maintaining rallies and attacking opponents (Francis, 2014).

Squash, unlike some other sports, requires players to move in an enclosed space with fixed dimensions. This demands a quick and precise motor response from the player. Activities such

as running forward, backward, sideways, and body rotation are carried out repeatedly in a relatively long duration of the match. It is in this context that the ability to change of direction is not only related to linear speed, but also to the ability to control the body in dynamic situations (Loturco et al., 2019). COD determines the efficiency of a player's movement when chasing the ball, returning to a neutral position, and maintaining the continuity of the game. Without good COD skills, a player will more easily lose points due to delayed response or body imbalance when moving.

To improve COD abilities, one of the most recommended methods of physical exercise is plyometric exercises. Plyometric training is a form of explosive exercise that aims to increase muscle strength quickly through rapid and strong muscle contractions (Juntara, 2019; Radcliffe, 2024). The main principle of this exercise is the stretch-shortening cycle (SSC), which is the use of eccentric phases followed by rapid concentric contractions to produce greater power (Fukutani et al., 2021). This exercise involves a variety of jumping, jumping, and bouncing movements, which are able to significantly develop the explosiveness of the leg muscles as well as neuromuscular coordination. Several studies show that plyometric training not only increases muscle strength, but also improves the body's overall speed, agility, and reactivity (Sinuhaji & Salsabila, 2025).

In the context of squash, plyometric training has great potential to improve athletes' performance, especially in the aspect of changing direction speed. Movements in plyometric exercises, such as lateral bounds, jump squats, depth jumps, and single-leg hops, are highly relevant to the movement patterns that occur in squash. These exercises help develop the body's ability to absorb the weight when landing and immediately make a push in a different direction (Comfort et al., 2024; Radcliffe, 2024). This means that the ability to accelerate and deceliate in a short period of time that is so much needed in squash can be improved through a structured plyometric training program.

Although many studies have shown the effectiveness of plyometric training in improving the physical performance of athletes in sports such as football, basketball, and athletics, studies that specifically examine its effect on squash athletes are limited, especially in the student or college athlete population. This is an important gap in sports research, especially in the context of developing specific, evidence-based physical training. Squash players at the Faculty of Sports Sciences, State University of Makassar (FIKK UNM) are a potential group to be the subject of research, considering their educational background that supports understanding of the training process and performance measurement.

In practice, physical training programs for squash players at the university level still do not fully integrate the principles of explosive exercises such as plyometrics. Most programs still focus on technique training, endurance, and general strength. In fact, plyometric integration can provide additional stimulus that is specific and relevant to the needs of squash movement. Therefore, it is necessary to conduct a scientific study that investigates the effect of plyometric training on the components of changing the direction of squash players, in order to provide a scientific basis for the preparation of a more effective and efficient training program.

Based on this exposure, this study is important to find out the extent of the influence of plyometric training on the ability to change of direction of squash players. The results of this research can later be a basis for consideration for coaches, lecturers, and sports practitioners in developing physical exercise programs that are specific to squash needs. With strong empirical

evidence, the development of squash athletes performance in the FIKK UNM environment can be directed more systematically and data-based.

2 Method

2.1 Design, Population and Research Sample

This study uses a quantitative approach with a pretest-posttest control group design. This design allowed researchers to compare changes in performance between the treated group (plyometric exercise) and the untreated group (the control group). With this approach, it can be measured to what extent the influence of plyometric exercises on the improvement of the change of direction (COD) ability of squash players. The subjects in this study are students who are members of the Squash Student Activity Unit (UKM) FIKK UNM who actively participate in exercises and competitions. The sample size was 20 people, who were randomly divided into two groups:

a. Experimental group (n = 10): got a plyometric exercise program.
b. Control group (n = 10): continued to follow a regular exercise program without plyometrics.

2.2 Plyometric Training Program

Plyometric exercises are a form of physical exercise designed to increase the ability of muscles to produce power explosively. Plyometric exercises generally involve movements such as jumps, jumps, and rebounds that stimulate the nervous and muscular systems to work faster and more efficiently. In addition to increasing explosive power, these exercises also help improve neuromuscular coordination, reactivity, and biomechanical efficiency of movement. The exercise program must be arranged gradually, starting from basic exercises to more complex and intensive forms, so that the body's adaptation runs optimally and the risk of injury can be minimized.

Week	Exercise Focus	Types of Exercise	Volume	Frequency
1	Basic techniques & adaptations	Squat Jump Standing Long Jump-Lateral Jump	2 set x 8–10 reps	2 sessions/ week
2	Coordination & stabilization	Box Step Jump (low box) Jump Over Cone Skater Jump	2–3 set x 8 reps	2 sessions/ week
3	Increased intensity	Depth Jump (20–30 cm) Tuck Jump Lateral Bound	3 set x 6–8 reps	2 Sessions/ week
4	Variations in direction of motion	Zig-Zag Hops Single Leg Hop (alternately) Lateral Box Jump	3 sets x 6 reps per direction/ leg	3 sessions/ week

5	Explosiveness & speed	Bounding Depth Jump + Sprint Jump Lunges	3–4 set x 6–8 reps	3 sessions/ week
6	Combinations & performance	Complex Drill (Tuck Jump + Sprint) Box Jump (high) Burpee Jump	3–4 set x 6–10 reps	3 sessions/ week

2.3 Illinois Agility Test (IAT)

To measure the ability to change of direction, researchers used the Illinois Agility Test (IAT). This test is used to measure a person's agility, which is the body's ability to change direction quickly and precisely while maintaining balance and body control. This test is often used in the world of sports to assess the agility of athletes, especially in branches that require a quick change of direction. This test has been tested for its validity and reliability to measure speed and agility in changes of direction. This instrument was chosen because it is in accordance with the characteristics of movements in squash, namely fast and repetitive movements in various directions.

Illinois Agility Test Measurement Procedure:

a. The subject starts from the starting position in a sprint-ready state.
b. Follow a zig-zag trajectory between the cones for 10 meters.
c. Travel time was recorded with a digital stopwatch by two loggers, and the average value was used for analysis.
d. Measurements were taken twice (pre-test and post-test), respectively before and after the 6-week intervention.

3 Result

To determine the effect of plyometric training on the ability to change of direction in FIKK UNM squash players, data analysis was carried out consisting of descriptive statistics, normality test, homogeneity test, and paired sample t-test. The results of the analysis are presented in the following tables:

3.1 Deskriptive statistic

The table below presents descriptive statistical results in the form of mean values, standard deviation, minimum and maximum values of pre-test and post-test results of change of direction ability in plyometric and control groups.

Data groups		Mean	Std. Deviation	Minimum	Maximum
Plyometri	Pre-test	17.175	0.270	16.80	17.60
	Post-test	15.755	0.209	15.40	16.10
Control	Pre-test	17.165	0.187	16.90	16.85
	Post-test	17.035	0.156	17.45	17.30

The plyometric group showed an average decrease in time from 17,175 seconds in the pre-test to 15,755 seconds in the post-test. This decrease indicates an increase in the ability to change of direction after being given plyometric exercise treatment. In contrast, the control group experienced a smaller decrease, from 17,165 seconds to 17,035 seconds. The relatively small standard deviation in both groups suggests that the data has a low spread around the mean value.

3.2 Normality test

The table below shows the results of the normality test using Shapiro-Wilk to determine whether the pre-test and post-test data in each group were normally distributed.

Data groups		Shapiro-Wilk Statistic	p-value
Plyometri	Pre-test	0.9598	0.784
	Post-test	0.9671	0.863
Control	Pre-test	0.9606	0.793
	Post-test	0.9085	0.271

All p-values on the Shapiro-Wilk test above 0.05 indicate that the data in each group (both pre-test and post-test) are normally distributed. Thus, the assumption of normality is met and further analysis can use parametric tests such as paired sample t-test and independent t-test.

3.3 Paired Sample T-test

The table below presents the results of the paired sample t-test which is used to determine the difference in pre-test and post-test results in each group, both the plyometric group and the control group.

Data groups	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Plyometri (Pretest-Posttest)	0.270	16.80	17.60	27.44	9	0.00
Control (Pretest-Posttest)	0.13	0.059	0.019	.005	9	0.00

The plyometric group showed a very significant difference between pre-test and post-test ($p < 0.001$), with an average difference of 1.42 seconds, indicating an increase in change of direction ability. The control group also showed significant differences ($p < 0.001$), but with a much smaller increase of 0.13 seconds. This suggests that plyometric training has a much greater influence on the improvement of these abilities than without exercise.

3.4 Independent Sample T-test

The table below shows the results of the independent sample t-test which aims to determine the difference in post-test results between the plyometric group and the control group.

Data group	Mean	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Plyometri	0.27	-15.51	18	0.00	-1.28	0.082
Control	0.13					

The test results showed a very significant difference between the two groups ($p < 0.001$). The average time of the plyometric group was 15.76 seconds, while the control group was 17.04 seconds, with a difference of 1.28 seconds. The value of $t = -15.51$ showed that the plyometric group performed significantly better after being given the plyometric exercise treatment. This proves that plyometric training has a significant effect on improving the change of direction ability of squash players.

4 Discussion

This study aims to determine the effect of plyometric training on the ability to change of direction in FIKK UNM squash players. From the results of data processing and statistical analysis, findings were obtained that showed a significant improvement in performance after the subjects underwent a plyometric training program for several weeks. Plyometric training is a form of exercise that combines fast and explosive movements, such as jumping, repulsion, and landing, aimed at improving muscle strength and neuromuscular efficiency (Fischetti et al., 2018; Hanafi & Prastyana, 2020; Wang et al., 2023). In the context of sports such as squash, which require reaction speed, acceleration, and sudden changes of direction, this type of exercise has a high relevance. The results of this study prove that the basic principles of plyometric training—namely the use of short stretch-short cycles—can significantly improve the quality of changes in the direction of an athlete's movement.

In general, the study participants showed a positive response to the exercise program given. Almost all subjects experienced a decrease in the time required to perform a change of direction maneuver. The decrease in time shows an increase in movement efficiency and the ability of muscles to produce power quickly and effectively. These positive changes can also be linked to physiological adaptations such as increased leg muscle strength, neuromotor coordination, and better proprioceptive abilities. One of the strengths of this research lies in the consistency of performance improvement shown by the individual change graph. Almost all subjects experienced a decrease in time in the implementation of the task of change of direction, with no indication of performance decline or regression. This phenomenon reflects that the plyometric exercises applied are well received by the players and have an equally positive effect. The absence of a decrease in performance is also an indicator that the volume and intensity of training have been designed appropriately according to the physical condition of the player. The findings in this study support the results of previous studies that stated that plyometric exercises are effective in improving speed and agility abilities. Several previous studies have shown that plyometric exercises can increase agility, speed, and explosiveness in a variety of sports, including football, basketball, and badminton (Chandra et al., 2023; Dharani et al., 2020; Huang et al., 2023; Purnami & Purnomo, 2019; Rahman et al., 2023). The study adds to evidence that similar benefits can also be obtained in the context of squash, which requires a quick response and the ability to change direction abruptly in tight spaces.

From a practical point of view, the results of this study provide relevant implications for coaches, physical education teachers, and competitive sports actors. Plyometric exercises can be used as part of a regular exercise program, especially for the purpose of increasing agility and changing direction. However, it is important to note that these exercises must be performed with correct technique and sufficient supervision, since their explosive nature carries a risk of injury if not carried out with adequate physical preparation. Although the results show a significant influence, there are some limitations that need to be noted. First, the number of samples used is relatively small and limited to one institution, so generalization of results to a wider population needs to be done carefully. Second, the relatively short duration of the exercise may not fully reflect the long-term adaptation potential of the plyometric program. Therefore, follow-up studies are recommended to be conducted with a larger number of participants and longer intervention periods, as well as to involve control groups to strengthen the validity of the results. In addition, external factors such as individual motivation, variation in playing style, and athletes' experience can also affect training results. In this regard, further studies with a qualitative approach may be needed to explore how athletes perceive plyometric training and how they integrate it into their daily training. The addition of measurement variables such as muscle strength, endurance, and the subjective perception of athletes can also enrich the interpretation of future results.

Overall, this study shows that plyometric training is an effective and applicable method in improving the ability of squash players to change direction. These findings reinforce the understanding of the importance of explosive exercise in the context of fast-reaction and position-based exercises. The addition of this exercise in the athlete development program can improve the competitive performance of players, especially in the face of dynamic game situations that demand instant movement adaptation.

5 Conclusion

Based on the results of data analysis and discussions that have been carried out, it can be concluded that plyometric exercises have a significant influence on improving the ability to change of direction in FIKK UNM squash players. The application of plyometric exercises in a structured manner is able to increase the speed, agility, and ability of muscles to respond to changes in the direction of movement quickly and efficiently. Almost all subjects experienced improved performance after undergoing the training program, which was characterized by a shorter time to execute the task of changing direction. This shows that plyometric training is effective in improving the quality of explosive motion that is needed in the game of squash. Thus, this exercise deserves to be an integral part of the physical development program of athletes, especially to improve functional motor performance related to agility and quick reactions.

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