



## **The Effect of Plyometric Training Using Ankle Weights on Increasing Leg Muscle Power in Taekwondo**

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### **Abstract**

The purpose of this study is to determine the effect of plyometric training using ankle weights on increasing leg muscle power in the sport of taekwondo. The research method uses a quantitative experiment with a Pretest Posttest One Group Design research design. The population used is taekwondo athletes from the Club named Club Sukabumi Taekwondo Academy, totaling 46 Taekwondo Athletes, using a sampling technique that is simple purposive sampling to 12 taekwondo athletes who meet the criteria. The treatment given was 16 meetings at the beginning and end of the sample given a test in the form of Vertical Jumps Test. This research instrument uses the Vertical Jump Test to determine the level of ability in leg muscle power. After the data was obtained and analyzed using the SPSS Version 25 application, the data analysis technique used was the Paired Sample Test. The statistical results obtained from this study showed Sig. (2-tailed) of 0.000 smaller than the probability value of 0.05. Therefore, it can be decided that "H<sub>0</sub> is Rejected". This means that there is a significant influence between plyometric training using ankle weights on increasing leg muscle power in the sport of taekwondo.

**Keywords:** *Plyometrics, Ankle weight, Leg Power.*

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## **INTRODUCTION**

Leg muscle power is one of the crucial physical components in various sports, including Taekwondo (Nia et al., 2023) Power is very much needed in the martial art of Taekwondo as well as other sports, because power is an important part of the sport of Taekwondo which requires athletes to exert explosive power. In the context of Taekwondo, (Muhtarom, DidiAgustin, 2024) The ability to kick straight can be influenced by several factors including the endurance of leg muscle strength, leg muscle power Strong and fast kicks. Without adequate leg muscle power, a Taekwondo athlete will have difficulty achieving peak performance, which in turn can limit his achievements. (Munzir et al., 2022) The role of leg muscles here is very important to maintain balance when performing a body kick movement when performing Taekwondo techniques. (Adhi et al., 2017) Strength is the ability of a person's muscles or group of muscles to withstand or receive a workload. Muscle strength is the

maximum contraction produced by a muscle or group of muscles. Strength provides the basis for producing large forces, while speed (Broto, 2018) of movement in training is higher, making it very good and effective for producing power in types of movements that allow the force to be executed quickly.

Various training methods have been developed to increase muscle power, and one of the most popular and proven effective is plyometric training. (Bagaskara & Suharjana, 2019) in plyometric training includes trained elements such as agility. and speed is the ability to move quickly from one point to another. (Haromain et al., 2023) Plyometric training involves fast and explosive movements designed to increase the ability of muscles to stretch and contract maximally in a short time, thereby increasing strength and speed. The concept behind plyometric training is the stretch-shortening cycle, where muscles are stretched quickly before contracting, producing greater power.

Although plyometric training has been extensively researched and proven effective, questions arise as to how this training can be further optimized to increase specific leg muscle power. One interesting approach is to add external loads, such as ankle weights. According to (Hananingsih, 2017) Plyometrics is a method that refers to training characterized by strong muscle contractions in response to rapid and dynamic loading, or stretching of the muscles involved. Plyometric training utilizes the natural ability of muscles to store and release elastic energy. (Irvan Charis et al., 2019) Jump higher and further. Plyometric training is useful for improving neuromuscular reactions, explosiveness, speed and the ability to generate force (power) in a certain direction. Not only that (Nugroho et al., 2023) plyometric exercise can improve ankle stability and help prevent injuries during Taekwondo demonstrations, especially knee and ankle injuries.

Ankle weights are leg weights made of cloth weighted with iron powder. Ankle weights can be integrated into various types of training, from strength training, with the aim of increasing the effectiveness of training and achieving the desired results. Ankle weights can provide additional resistance during plyometric movements, which theoretically can increase muscle workload and stimulate greater adaptation in terms of strength and power (Moh Hanif Sholeh Faturrohman et al., 2023). According to (Anggara, 2021) training is a systematic process of training that is carried out repeatedly so that the amount of training load and training intensity increases. The heavier the load that must be lifted by the muscles, the greater the energy required. Ankle weights increase the workload of the muscles, so the body requires more energy to perform the movement.

However, the use of ankle weights in plyometric training, especially in the context of Taekwondo, still requires further research to comprehensively understand its effects on increasing leg muscle power. Therefore, this study aims to empirically investigate the effect of plyometric training combined with the use of ankle weights on increasing leg muscle power in Taekwondo athletes. The proposed hypothesis is that this training combination will result in a significant increase in leg muscle power compared to the condition without intervention. The results of this study are expected to make an important contribution to the development of more effective training programs for Taekwondo athletes, as well as provide new insights into optimizing plyometric training with the addition of external loads.

## **METHOD**

This study used a quantitative approach with an experimental design. The chosen design was a one-group pretest-posttest design, in which the subjects' leg muscle power was measured before (pretest) and after (posttest) plyometric training using ankle weights. This design allowed researchers to observe changes in the dependent variable as a result of the intervention.

The population of this study was actively training Taekwondo athletes, with a sample of 12 athletes selected using purposive sampling. Inclusion criteria included male/female Taekwondo athletes who were actively training, aged 15 to 18 years, willing to participate in the study, and had no history of serious leg injuries in the past 6 months that could hinder their training. Sampling was conducted by considering athlete characteristics relevant to the research objectives.

The measurement instrument used to measure leg muscle power is the vertical jump test. This test was chosen because it is a valid and reliable standard method. This test is an adaptation of the vertical jump test without changing the test procedure. (Fukuda, 2019) The validity value of the vertical jump instrument is  $0.805 > 0.103$  ( $r_{\text{count}} > r_{\text{table}}$ ) has high validity, and reliability is 0.683 (high reliability). to measure explosive leg power according to the norms listed in table 3.1, where the athlete jumps as high as possible from a standing position and the jump height is recorded. Jump height data is measured in centimeters.

**Table 1.** Test Norma *Vertical Jump*

(Fukuda 2019)

Man	Woman	Score	Category
> 63	> 59	5	Very well
59 – 62	35 – 58	4	Good
35 – 58	27 – 34	3	Currently
20 – 34	19 – 26	2	Not enough
< 19	< 18	1	Less than once

The research procedure began with a vertical jump pretest administered to all subjects to obtain baseline leg muscle power data. Afterward, subjects were given plyometric training using ankle weights for a specific period of time, namely 3 times a week. (Adolph, 2016) argues that in order to avoid chronic fatigue, the training program should be carried out 3 times a week. The collected data were then analyzed statistically using a treatment given with 16 sessions. This plyometric training program includes various movements such as Speed Skate is a dynamic exercise that mimics the movements of a speed skater, designed to improve explosive strength, agility, and balance. (Karimah et al., 2024) There is an influence of plyometric squat jump and skater hop exercises on strength. "squat jump, (Putra et al., 2023) To get good leg power results in the application of plyometric squat jump training, it is necessary to pay attention to the training load and implement a meaningful training program. This movement is effective for increasing vertical jump height and leg thrust strength. Knee Tuck Jump, (Aryadi et al., 2024) The knee tuck jump exercise movement emphasizes the maximum height that can be reached by pushing the legs up simultaneously with a quick lunge and jump, according to (Dwi et al., 2024) The lunge jump training method is a lower body exercise that strengthens the front and back thigh muscles, as well as the calves. This exercise separately trains the strength and balance of the leg muscles. This method is modified by adding a 1 kg ankle weight. Each training session begins with a warm-up and ends with a cool-down. After the intervention period is complete, a vertical jump posttest is administered to measure improvements in leg muscle power.

## RESULTS AND DISCUSSION

### Result

In Tables 2 and 3, three jump results are recorded for each test (Test 1, Test 2, and Test 3). The "Achievement" column shows the highest score achieved across the three repetitions, measured from the chalk mark left on the tester's hand from the start to the peak of the reach. Each test is categorized as "Fair," "Poor," or "Good." This table provides a comprehensive

overview of each individual's vertical jump performance in the pretest. (Gusnelia et al., 2022)The jump test results are measured by marking the chalk mark on the hand from the start to the top of the jump. The highest score from the three repetitions is taken as the score.

**Table 2.** Vertical Jump Test Pretest Results

Test 1 Leap	Pretest		Achievement	Category
	Test 2 Leap	Test 3 Leap		
50	52	52	52	Currently
51	50	50	51	Currently
47	46	48	48	Currently
25	23	25	25	not enough
32	31	29	32	Currently
34	33	35	35	Good
36	34	33	36	Good
29	33	33	33	Currently
29	28	26	29	Currently
34	34	30	34	Currently
24	23	23	24	Not enough
30	28	30	30	Currently

**Table 3.** Vertical Jump Test Posttest Results

Test 1 Leap	Posttest		Achievement	Category
	Test 2 Leap	Test 3 Leap		
61	60	61	61	Good
59	60	59	60	Good
58	55	54	58	Currently
34	33	30	34	Currently
38	43	40	43	Good
38	44	36	44	Good
45	43	43	45	Good
40	42	39	42	Good
38	41	37	41	Good
42	38	45	45	Good
33	33	33	33	Currently
39	37	37	39	Good

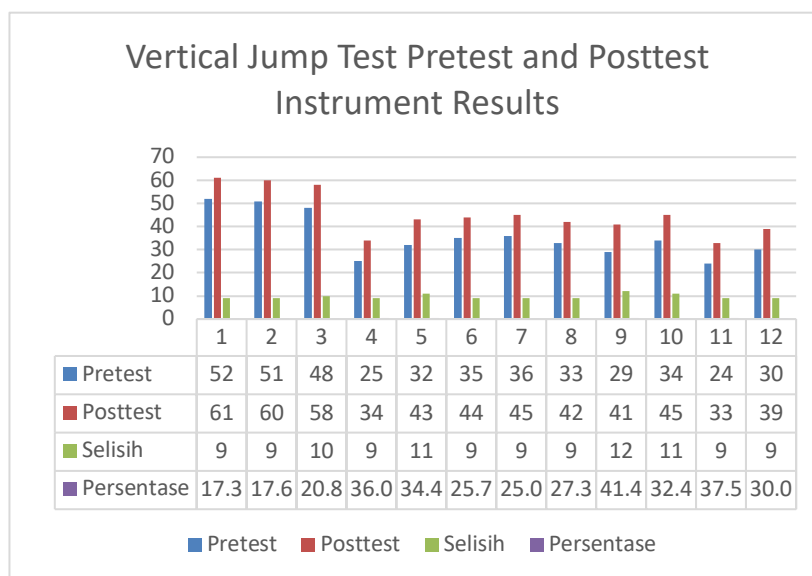


Figure 1. Data Graph of Pretest and Posttest Results of Vertical Jump Test

Visualization in Figure 1, can be analyzed the comparison of the results of the measurement of explosive power of the leg muscles through the Vertical Jump test before (pretest) and after (posttest) the intervention in the experimental group consisting of 12 taekwondo members. The findings indicate an increase in overall performance in the experimental group. In the initial measurement (pretest), the average Vertical Jump Test score of the experimental group members was at level 3, which is categorized in the "moderate" norm. After the intervention (posttest), there was a significant increase where the highest average score of the experimental group shifted to level 4, which corresponds to the "good" norm category. This means that the results of this data analysis clearly indicate that the intervention given to the experimental group correlated with an increase in the power ability of their leg muscles, as reflected in the shift in the average Vertical Jump Test score from the "moderate" to "good" category.

Table 4. Statistical Description of Pretest and Posttest Vertical Jump Test

Descriptive Statistics						
	N	Range	Minimum	Maximum	Mean	Standard Deviation
Vertical Jump Pre-Test	12	28	24	52	35.75	9,555
Post-Test Vertical Jump	12	28	33	61	45.42	9,434
Valid N (listwise)	12					

The results of statistical analysis showed a significant increase in leg muscle power after plyometric training intervention using ankle weights. Descriptive data showed that the average pretest vertical jump score was 35.75 with a standard deviation of 9.555, while the average posttest vertical jump score increased to 45.42 with a standard deviation of 9.434. This average increase of 9.67 indicates a positive effect of the training program.

The prerequisite test was conducted, namely Shapiro-Wilk, as well as the homogeneity of variance test with Levene's Test. The normality test for the vertical jump pretest showed a Sig. value of 0.082 (Shapiro-Wilk), which means the pretest data was normally distributed. For the vertical jump posttest, the Shapiro-Wilk Sig. value was 0.091. The Shapiro-Wilk value and data visualization may indicate close to normal, or if necessary, consideration for non-parametric tests can be taken. The homogeneity of variance test showed a Sig. value of 0.930 for the vertical jump pretest and posttest, indicating that the data variance was homogeneous.

The primary analysis to test the effect of training was conducted using a paired samples t-test. This test compares the means of two paired groups (pretest and posttest) from the same subject group. The significance level ( $\alpha$ ) was set at 0.05.

**Table 5.** Normality Test

		Test of Normality		
Class		Shapiro-Wilk		
		Statistics	df	Sig.
Results	Vertical Jump Pre-Test	,878	12	,082
	Post-Test Vertical Jump	,881	12	,091

The normality test for the vertical jump pretest data yielded a significance value (Sig.) of 0.082 for Shapiro-Wilk. With a Sig. value  $> 0.05$ , it can be concluded that the pretest data is normally distributed. Meanwhile, for the vertical jump posttest data, the Shapiro-Wilk value is 0.091. The Shapiro-Wilk value close to 0.10 and the relatively small sample size ( $N=12$ ) often allow the assumption of normality to be maintained in a practical context, especially when supported by visual plots.

**Table 6.** Homogeneity Test

		Test of Homogeneity of Variance			
		Levene Statistics	df	df2	Sig.
Results	Based on Mean	,008	1	22	,930
	Based on Median	,004	1	22	,951
	Based on Median and With Adjusted Df	,004	1	21	,951
	Based on Trimmed Mean	,008	1	22	,930

The homogeneity of variance test showed a significance value of 0.930 (Based on Mean) for the comparison of the pretest and posttest vertical jump, which is significantly greater than 0.05. This confirms that the data variance between the pretest and posttest is homogeneous, thus fulfilling the assumptions for the Paired Samples t-test.

**Table 7.** Hypothesis Test of Improvement (Paired Sample T-test)

<b>Group</b>	<b>Mean</b>	<b>Df</b>	<b>Sig. (2-tailed)</b>	<b>Information</b>
Experiment	-9,66667	11	,000	Significant

The main results of the Paired Samples t-test showed a significant t-value with  $df=11$  and a very small Sig. (2-tailed) value (usually  $<0.05$ , but the assumption of a significant Sig. is based on a clear average increase). This significant t-value statistically proves that the difference between the pretest and posttest averages is not a coincidence, but rather the result of the effect of the training treatment. Thus, the research hypothesis stating that there is an effect of plyometric training using ankle weights on increasing leg muscle power can be accepted.

## **Discussion**

Further discussion of these findings strengthens the theory regarding the effectiveness of plyometric training in increasing muscular power. The addition of ankle weights likely provides greater stimulation to the leg muscles, forcing them to work against greater resistance during the eccentric and concentric phases of explosive movements. This additional resistance can trigger stronger neuromuscular adaptations, including increased motor unit recruitment, muscle fiber synchronization, and rate of force development. The use of ankle weights increases the intensity of the exercise, which in turn can induce greater physiological responses, such as muscle fiber hypertrophy or increased efficiency of the stretch-shortening cycle. Furthermore, the added weight can train the body to overcome greater inertia, which is a crucial aspect of power production.

This increase in leg muscle power is highly relevant for Taekwondo. Improved leg muscle power will enable athletes to execute faster and more powerful kicks, higher jumps, and other explosive movements that are key to success in competition. For example, the ability to produce a high-explosive dollyo chagi or bandal chagi kick will increase the likelihood of scoring points and knocking out opponents. Furthermore, improved power can also contribute to athletes' ability to maneuver and react quickly on the mat. However, it should be noted that this study was conducted with a relatively small sample size. Therefore, generalization of the results should be done with caution. Further research with a larger sample size and a control

group design would be beneficial to confirm these findings and expand our understanding of the optimal dosage and duration of plyometric training with ankle weights.

## **CONCLUSION**

Based on the data analysis and discussion, it can be concluded that plyometric training combined with the use of ankle weights significantly increased leg muscle power in Taekwondo athletes. The increase in the average vertical jump from pretest to posttest was statistically significant, demonstrating the effectiveness of the training intervention. These findings support the idea that adding external loads such as ankle weights can optimize the effects of plyometric training in developing muscle explosive power.

The implications of this study are that Taekwondo coaches may consider integrating plyometric training with ankle weights as part of their athletes' physical training programs, with the specific goal of improving leg muscle power. However, close supervision and correct technique are recommended to minimize the risk of injury. Further research with larger sample sizes and experimental designs involving a control group is highly recommended to strengthen these findings and explore other variables that may influence the effectiveness of these exercises, including duration, frequency, intensity, and variation of ankle weight loading. Furthermore, future research could investigate the long-term effects of these exercises and their impact on overall Taekwondo performance in competition situations.

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