



The Effect of Lunges and Squat Jump Exercises on Leg Muscle Strength of Taekwondo Athletes at DATC Rembang

Sabrina Violeta Anggraini¹, Sahri²

^{1,2}Faculty of Sports Science, Universitas Negeri Semarang, Indonesia..

E-mail: sabrinavioletaa@students.unnes.ac.id¹, sahri@mail.unnes.ac.id²

Abstract

Taekwondo relies heavily on leg muscle strength, as it plays a crucial role in producing effective and explosive kicks. An appropriate training program is necessary to optimize muscle power production. This study aims to analyze whether there is an influence on leg muscle strength and compare the effectiveness of the two methods on taekwondo athletes at DATC Rembang from lunges and squat jumps. Experimental research was implemented using a pretest–posttest control group design. Twenty taekwondo athletes aged 13 to 18 served as subjects, divided into two treatment groups: the lunges group and the squat jump group. The training program was conducted for six weeks, three times per week. A digital leg dynamometer was used to measure leg muscle strength, and the Shapiro–Wilk test, Levene's test, paired sample t-test, and independent sample t-test were implemented to analyze the data with a significance level of 0.05. The research findings showed that leg muscle strength is significantly effected by training methods ($p < 0.05$), and there was a significant difference between the two methods, with squat jumps being more effective than lunges. It can be concluded that leg muscle strength in adolescent taekwondo athletes can be optimally improved by plyometric-based training.

Keywords: lower limb muscle strength, squat jump, lunges, plyometric, taekwondo, physical training

INTRODUCTION

Taekwondo is one of the martial arts sports that has developed rapidly in Indonesia and is regularly contested in regional, national, and international competitions. The characteristics of modern taekwondo matches, particularly in the kyorugi category, are dominated by high-intensity kicking techniques, high movement speed, and dynamic combinations of attack and defense. These conditions require athletes to possess optimal physical components, especially lower limb muscle strength, which serves as the primary support in producing powerful, stable, and effective kicks. Lower limb strength plays an important role in generating propulsive force, maintaining body balance when one leg becomes the base of support, and facilitating rapid transitions between techniques (Irawan & Rachman, 2020).

In the process of sports development, physical conditioning programs must be systematically designed and based on scientific principles to produce significant performance improvements. Lower limb muscle strength and power can be enhanced through the implementation of plyometric training. Structured plyometric programs conducted over several weeks have been shown to significantly improve lower limb power and strength (Wibowo & Sugiharto, 2019). These findings indicate that neuromuscular adaptations resulting from jump-based exercises can optimize the contractile capacity of lower limb muscles.

More specifically, improvements in lower limb strength and explosive power can be effectively achieved through squat jump training as a form of plyometric exercise. Pratama and Nugroho (2021) stated that “lower limb muscle strength in athletes can be significantly improved through a structured six-week squat jump program.” On the other hand, lunges are categorized as bodyweight strengthening exercises that emphasize unilateral muscle work, thereby improving lower limb strength, stability, and balance. Hidayat and Kusuma (2022) stated that “lower limb strength and athletes’ postural control can be effectively improved through bodyweight exercise variations such as lunges.”

Another study by Ramadhan et al. (2023) confirmed that plyometric training significantly contributes to improving physical condition components in martial arts athletes, particularly lower limb strength and power. However, most national studies have focused more on the power variable or have

been conducted in general sports such as soccer, volleyball, and athletics. Research specifically examining the effects of lunges and squat jump training on lower limb muscle strength in taekwondo athletes remains relatively limited, especially at the regional club level.

Based on the literature review, it appears that each training method—squat jump and lunges—has been proven effective separately in improving certain physical components. However, studies directly comparing the two methods in terms of their effects on lower limb muscle strength within the context of regional taekwondo athlete development are still very limited. Furthermore, no empirical research has been conducted on DATC Rembang athletes for the purpose of evaluating and developing club-level training programs.

In this regard, the scientific novelty of this study lies in the empirical examination of the effects of lunges and squat jump training on lower limb muscle strength in DATC Rembang athletes using a controlled experimental design. This study integrates two training methods that have individually proven effective but are rarely examined simultaneously in a regional taekwondo athlete population, with a primary focus on lower limb muscle strength.

The research problem addressed in this study is the lack of empirical evidence regarding the significant effects of lunges and squat jump training on improving lower limb muscle strength in DATC Rembang taekwondo athletes, as well as determining the most effective method. Based on this problem, the research hypotheses are: (1) there is a significant effect of lunges training on lower limb muscle strength; (2) there is a significant effect of squat jump training on lower limb muscle strength; and (3) there is a difference in the effects between lunges and squat jump training on the improvement of lower limb muscle strength.

This study aims to analyze the effects of lunges and squat jump training on lower limb muscle strength in DATC Rembang taekwondo athletes and to determine the most effective training method for improving this key component of taekwondo performance.

METHODS

This study employed an experimental method using a pretest–posttest control group design to address the research problem regarding the effects of lunges and squat jump training on the lower limb muscle strength of DATC Rembang taekwondo athletes. This design was chosen because it allows researchers to identify changes before and after the intervention and to objectively compare the effectiveness of the two training methods. Conceptually, the research design involved two treatment groups, each receiving a different intervention, which were then compared based on pretest and posttest results.

The study was conducted at the DATC (Dampo Awang Taekwondo Club) located in Rembang Regency. The research lasted six weeks with a training frequency of three sessions per week, resulting in a total of eighteen training sessions. The schedule was adjusted to the athletes' regular training program to avoid disrupting the existing development process.

The research subjects consisted of 20 active DATC Rembang taekwondo athletes who met the inclusion criteria: aged 13–18 years, having at least one year of training experience, being in good physical condition, and not experiencing lower limb injuries during the study. The sample was determined using a total sampling technique, meaning all eligible members of the population were included as research participants. Group assignment was conducted using a matching technique based on pretest scores to ensure relatively equal initial abilities between groups and to minimize bias due to baseline differences.

In this study, lunges and squat jump training served as the independent variables, while lower limb muscle strength was the dependent variable. The measurement indicator used to assess strength was the score obtained from a digital leg dynamometer with an accuracy of ± 0.5 kg and a maximum capacity of 300 kg. Measurements were performed in a standing position according to standard lower limb strength testing procedures, where subjects pulled the dynamometer handle maximally using leg strength. Each subject was given two attempts, and the highest score was recorded as the final result. In



addition to the dynamometer, a digital scale (± 0.1 kg accuracy) was used to record body weight as supporting data, and IBM SPSS Statistics software was used for data analysis.

The research procedure began with a pretest to measure the lower limb muscle strength of all participants. After the initial measurement, the first group underwent a lunges training program for six weeks with gradually increasing intensity based on the principles of overload and progression. The training consisted of three to four sets with 10–15 repetitions per set. The second group followed a squat jump training program with the same frequency and duration. Squat jump exercises were performed as repeated vertical jumps with sets and repetitions adjusted according to plyometric training principles.

After the intervention period, all participants completed a posttest using the same procedures as the pretest. The data obtained were lower limb muscle strength scores expressed in kilograms (kg). Data analysis included calculating the mean and standard deviation as descriptive statistics. The Shapiro–Wilk test was used to assess data normality, and Levene’s test was used to examine variance homogeneity before hypothesis testing. A paired sample t-test was used to analyze the effect of training within each group, while an independent sample t-test was used to analyze differences between groups. All tests were conducted at a significance level of $\alpha = 0.05$.

These analytical methods were selected because they are appropriate for a two-group experimental design with pre- and post-intervention measurements, enabling the study to determine whether there is an effect and whether there are differences in effectiveness between lunges and squat jump training on lower limb muscle strength in DATC Rembang taekwondo athletes.

RESULTS AND DISCUSSION

Research Results

This study aims to determine which has a more significant impact on lower leg muscle strength in taekwondo athletes at the Dampo Awang Taekwondo Club in Rembang. The subjects were athletes at DATC consisting of 20 people. The study began with the collection of pre-test data on January 5, 2026 and ended with the collection of post-test data on February 13, 2026. The data were then analyzed using statistical analysis in the SPSS application, then analyzed descriptively to determine the picture of changes in strength. muscle legs below in athletes. A summary of the overall data description is presented in Table 1.

Table 1. Descriptive Statistics Results

Group		N	Minimum	Maximum	Mean	Std. Deviation
Lunges	Pretest	10	88	105	95.40	5.62
	Posttest	10	102	120	110.30	6.05
Squat Jump	Pretest	10	89	102	94.80	4.08
	Posttest	10	108	124	115.60	5.08

The data presented in Table 1 explains that In the lunges group, there was an increase in the range of leg muscle strength values from 88–105 kg. pretest to 102–120 kg at During the posttest, all athletes experienced improved performance after the training. An increase in the minimum score indicates that athletes with low initial abilities also experienced progress, while an increase in the maximum score indicates improved performance in athletes with high abilities. In the squat jump group, the increase was greater, from 89–102 kg in the pretest to 108–124 kg in the posttest, thus strengthening the statistical test results showing that this exercise had a significant effect on increasing leg muscle strength. These minimum and maximum data indicate that the increase occurred not only at the average value but also evenly across all study subjects. Furthermore, the higher maximum score in the squat jump group is in line with the results of the intergroup comparison that showed this method was more effective than lunges.

Table 2. Results of normality test

Group		Shapiro-Wilk Statistics	Sig. (p-value)	Remarks
Lunges	Pretest	0.962	0,807	Normal
	Posttest	0.955	0.738	Normal
<i>Squat Jump</i>	Pretest	0.971	0,902	Normal
	Posttest	0.948	0.655	Normal

The results of the normality test shown in Table 2 show that all data in the lunges and squat jump groups, both pretest and posttest, show a significance value (Sig.) > 0.05 . This indicates that the research data is normally distributed, thus fulfilling the basic assumptions in the use of parametric statistical tests. With these assumptions met, the analysis can be continued using paired t-tests to determine the effect of each treatment, as well as independent t-tests to compare results between groups. Thus, the data obtained can be considered appropriate and valid for use in testing the research hypothesis.

Table 3. Paired T-Test Results

Group	Mean Pretest	Mean Posttest	Mean Difference	t	df	Sig. (2-tailed)
<i>Lunges</i>	95.40	110.30	-14.90	-20,20	9	0,000
<i>SquatJump</i>	94.80	115.60	-20.80	-23,99	9	0,000

As shown in Table 3, both groups experienced an increase in mean scores from pretest to posttest. The paired t-test results showed a significance value of 0.000 ($p < 0.05$) in both groups, thus concluding that lunges and squat jumps significantly increased leg muscle strength. Furthermore, the mean difference in the squat jump group was greater than that in the lunges group, indicating that squat jumps were more effective in increasing leg muscle strength.

Table 4. Independent T-Test Results

Variables	Mean Lunges	Mean Squad	Mean Difference	t	df	Sig. (2-tailed)
Posttest	110.30	115.60	5.30	-2.32	18	0.032

Based on the results of the independent t-test, a significance value of 0.032 ($p < 0.05$) was obtained, indicating a significant difference between the lunges and squat jump groups. The average value of the squat jump group was higher than that of the lunges group, so it can be concluded that squat jump exercises are more effective in increasing leg muscle strength than lunges exercises.

Discussion

Research results and results Based on statistical analysis, this study showed that lunges and squat jumps significantly increased leg muscle strength in DATC Rembang taekwondo athletes. This is supported by the descriptive analysis, which showed an increase in average scores from pretest to posttest in both groups. Furthermore, improvements were also seen in the minimum and maximum scores, indicating that all study subjects experienced progress without any decline in performance.

The results of the normality test using the Shapiro-Wilk method showed that all data were normally distributed ($p > 0.05$). Thus, the data met the assumptions for parametric testing, allowing the analysis to proceed using paired t-tests and independent t-tests. The fulfillment of this normality assumption indicates that the test results have a good level of validity.

Furthermore, the results of the paired t-test showed that there was a significant difference between the pretest and posttest scores in both the lunges and squat jump groups ($p < 0.05$). In the lunges group, the average increase of 14.90 kg indicated that this exercise was effective in increasing leg muscle strength. This can be explained because lunges involve functional and simultaneous muscle contractions



in the main leg muscles, as well as demanding body balance. This activity encourages neuromuscular adaptations that contribute to increased muscle strength .

Overall, the results from the descriptive statistics table, normality test, paired t-test, and independent t-test show strong consistency. The increase in the average value (descriptive), normal distribution of data (normality), significant differences within groups (paired t-test), and differences between groups (independent t-test) together prove that both training methods are effective, but squat jumps provide more optimal improvements .

Theoretically, the results of this study align with training principles such as overload and progression, where regular and gradual training can increase muscle strength through physiological and neuromuscular adaptations. Furthermore, the differences in results between the two training methods indicate that the type of training plays a significant role in determining the level of improvement in an athlete's physical abilities.

From a practical perspective, the results of this study suggest that coaches can choose training methods based on their desired goals. Lunges can be used to improve core strength and stability, while squat jumps are more effective for increasing explosive power. Combining these two exercises can also be an optimal strategy for improving the overall performance of taekwondo athletes.

However, this study has limitations, including a relatively small sample size and being limited to a single club. Therefore, future research is recommended to involve a larger sample size, longer training duration, and the addition of other variables such as speed and agility to provide more comprehensive results.

CONCLUSION

This study aims to analyze the effect of lunges and squat jumps on leg muscle strength in taekwondo athletes at DATC Rembang and compare their effectiveness. The analysis results show that both training methods significantly increase leg muscle strength ($p < 0.05$), thus the first and second hypotheses are accepted. Furthermore, there is a difference in effectiveness between the two exercises, with squat jumps providing a higher increase than lunges, thus the third hypothesis is also accepted.

Scientifically, plyometric-based squat jump training is more effective because it utilizes the stretch-shortening cycle mechanism, which can increase explosive leg muscle strength, in line with the movement requirements of taekwondo. Therefore, squat jumps can be recommended as the primary method for increasing leg muscle strength, although lunges remain important for basic strength and stability.

For future research, it is recommended to use a longer intervention duration, add variations in combination exercises involving lunges and squat jumps, and examine other performance variables such as kick power, speed, and dynamic balance. Furthermore, the generalizability of the study results could be improved by involving a larger sample size and a more diverse age range of athletes.

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CONFESSION

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