

The Effect of Leg Power Training on Jumping Ability Far Squat Style in Students of PKL Department FIKKM Unima

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ABSTRACT

This study aims to examine and analyze the effect of leg power training on squat-style long jump performance among students in the Department of PKL at FIKKM, Universitas Negeri Manado (Unima). The study employed a true experimental method using a randomized pretest-posttest control group design. The study population consisted of all male students in the PKL Department. A total of 20 students were selected through purposive sampling and divided into two groups: an experimental group ($n = 10$) and a control group ($n = 10$), using an ordinal pairing technique. The research instrument was the squat-style long jump test. Data were analyzed using univariate and bivariate statistical methods. An independent-samples t-test was conducted at a significance level of $\alpha = 0.05$. The results demonstrated that leg power training had a statistically significant effect on improving squat-style long jump performance among students in the Department of PKL at FIKKM Unima, with an observed t-value ($t = 6.242$) exceeding the critical t-value ($t = 2.101$).

INTRODUCTION

Education is a priority for governments at both regional and national levels because a nation's progress is significantly influenced by the quality of education, which develops competent individuals who serve as the foundation of national development (Asamoah et al., 2025; Chhy & Kawai, 2025; Mudzakir & Aslan, 2025; Vasuki et al., 2026; Zhang, 2025). Education is a conscious effort undertaken by individuals to guide and direct their personal development and enhance their abilities. Through education, individuals develop their potential, supported by an environment that facilitates their growth. In the context of physical education, the development of athletic abilities, particularly in track and field, is an essential component of a holistic educational curriculum. Track and field events, including the long jump, are taught in schools and universities to develop physical fitness, motor skills, and a competitive spirit (Abdul Ali Kazem, 2026; Mus et al., 2025; Yednak et al., 2026).

Educational institutions, such as schools and universities, provide structured learning environments in which activities are planned and organized according to established curricula (Christou et al., 2024; Habrusiev et al., 2023; Kovtoniuk et al., 2022; Obi et al., 2022). To respond to evolving educational demands, curricula undergo continuous revisions and improvements to ensure that students acquire the knowledge and skills necessary to address present and future challenges. Schools and universities therefore serve as institutions that facilitate learning and support students in achieving their personal and professional goals. In accordance with the established curriculum, the Department of Coaching Education at FIKKM Unima offers an athletics course that includes instruction in the long jump. During athletics

lectures and specialized training sessions, some students demonstrate more advanced long jump skills than others. These abilities can be further developed through talent identification, specialized coaching, and competitive training programs in educational institutions and sports clubs.

The long jump is a track and field event in which athletes attempt to achieve the greatest possible horizontal distance from the takeoff board. The winner is determined by the longest valid jump recorded during the competition. Long jump performance requires a combination of speed, muscular strength, explosive power, and technical coordination. Jumping involves propelling the body through the force generated by the lower limbs. The primary objective of the long jump is to move the body horizontally through the air and achieve the greatest possible distance. Makadada (2023) stated that "The long jump is one of the jumping events in athletics. In a long jump competition, an athlete attempts to propel the body forward from the takeoff board with maximum force to achieve the greatest possible landing distance in the sandpit." Similarly, Haryanta and Sujatmiko (2012) explained that "The long jump is a jumping event that aims to achieve the greatest possible distance by moving the entire body from the takeoff point to the landing area. The technique involves running as fast as possible, performing the takeoff, maintaining body position during flight, and completing the landing."

The long jump involves taking off from one foot to achieve the greatest possible horizontal distance. According to Djumidar (2004), "The long jump is a movement performed to achieve a certain distance through a single jump. The primary objective of the long jump is to achieve the greatest possible distance from the takeoff point to the landing area or sandpit." Bahagia (2000) explained that "The horizontal distance achieved in the long jump is determined by the cumulative contribution of three components: (1) the horizontal distance between the takeoff foot and the athlete's center of mass at takeoff; (2) the horizontal displacement of the athlete's center of mass during the flight phase; and (3) the horizontal distance between the athlete's center of mass and the heels at landing, in accordance with the rules governing the long jump."

The squat-style long jump is a technique in which the athlete performs a sequence of movements consisting of the approach run, takeoff, flight, and landing. During the final steps of the approach run, the athlete maintains a high running speed while preparing for takeoff without significantly disrupting stride rhythm. The approach run generates the horizontal velocity required for an effective jump. During the takeoff phase, the athlete applies force against the takeoff board using the takeoff leg, converting part of the horizontal momentum into vertical momentum to achieve an optimal takeoff trajectory. During the flight phase, the athlete adopts a squat-like position by bringing the legs forward and coordinating arm movements to maintain balance and prepare for landing. The landing phase begins when both heels contact the sand, with the legs extended forward and positioned close together. The athlete subsequently flexes the knees and moves the body forward to minimize the loss of jumping distance.

The squat-style long jump is a complex motor skill involving a coordinated sequence of movements that cannot be performed effectively in isolation. Because of this complexity, achieving optimal performance requires proper technical execution supported by adequate physical conditioning. Based on the researcher's preliminary observations, the squat-style long jump performance of students in the Department of PKL at FIKKM Unima remains relatively

low, with recorded jumping distances ranging from approximately 2.0 to 2.5 m. These observations indicate a need to identify the factors contributing to limited performance and develop appropriate training interventions. Improving long jump performance requires systematic training supported by scientific principles from various disciplines, including exercise physiology, biomechanics, and sports training methodology. Several factors contribute to athletic performance, including physical conditioning, technical proficiency, psychological readiness, and competitive experience. Among these factors, physical conditioning plays a fundamental role in supporting effective movement execution. One of the essential physical components influencing long jump performance is lower-limb muscular power, which combines muscular strength and movement velocity. During the approach phase, running speed contributes to horizontal momentum, whereas during takeoff, explosive leg power is required to generate sufficient force for propulsion. The ability to produce force rapidly is commonly referred to as muscular power or explosive power.

Improving muscular power requires training programs tailored to the individual characteristics, physical capacities, and training needs of athletes. Even athletes participating in the same sport may demonstrate different levels of strength, speed, coordination, and physical readiness. Consequently, training interventions must be selected and implemented according to individual capabilities to maximize their effectiveness. In the context of long jump performance, leg power training is considered an appropriate intervention for enhancing the explosive strength of the lower limbs and improving the ability to generate force during takeoff.

Evidence from systematic reviews indicates that plyometric jump training produces moderate-to-large improvements in muscle strength and horizontal jump distance (Ramirez-Campillo et al., 2022), and that the orientation of plyometric training (vertical versus horizontal) influences the specific adaptations obtained (Moran et al., 2021). Complex training that combines strength and jumping exercises has also been reported to improve jump performance (Thapa et al., 2021), and an eight-week program combining strength and plyometric training improved lower-limb stiffness and jump performance in elite long jump athletes more than strength training alone (Xu et al., 2025). In addition, long jump takeoff depends on coordinated lower-limb joint actions, and restricted ankle dorsiflexion has been shown to alter takeoff velocity and joint kinetics (Zhang et al., 2025).

The long jump is a track and field jumping event that begins with an approach run to generate horizontal velocity, followed by takeoff, flight, and landing in a sandpit. Three commonly recognized long jump flight techniques are the squat technique, the hang technique, and the hitch-kick technique, also known as the walking-in-the-air technique. These techniques are used to control body position during flight and facilitate effective landing mechanics, thereby helping athletes maximize their jumping distance. Successful performance in this event depends on the implementation of systematic, well-planned, and effective training programs designed to develop the physical and technical abilities of athletes. Appropriate training interventions can positively influence long jump performance, particularly among students learning the squat-style technique in athletics courses.

The lower limbs consist of anatomical structures that include the thighs, legs, ankles, and feet. These structures play essential roles in supporting body weight, generating movement, and producing the force required for athletic activities. The skeletal structures of the lower limbs are connected to the trunk through the pelvic girdle. The principal bones involved include

the hip bones (ossa coxae), femur (thighbone), tibia (shinbone), fibula (lateral bone of the leg), patella (kneecap), tarsal bones (ossa tarsi), metatarsal bones (ossa metatarsi), and phalanges (toe bones). These skeletal structures, together with the surrounding muscles and joints, contribute to lower-limb stability, movement coordination, and force production. In long jump performance, the coordinated action of the hip, knee, and ankle joints is particularly important for generating explosive force during takeoff and maintaining effective body control throughout the jumping sequence.

Based on the observations and theoretical considerations presented above, the researcher considers it necessary to investigate whether leg power training significantly influences squat-style long jump performance among students in the Department of PKL at FIKKM Unima. Accordingly, this study was conducted under the title "The Effect of Leg Power Training on Squat-Style Long Jump Performance Among Students in the Department of PKL at FIKKM Unima." The primary objective of this research is to examine the effect of leg power training on students' squat-style long jump performance and determine whether the training intervention produces measurable improvements in jumping distance.

This research is expected to contribute to both theoretical knowledge and practical applications in sports science and physical education. Theoretically, it seeks to expand the existing literature on lower-limb muscular power training by providing empirical evidence regarding its effects on squat-style long jump performance among university students. Furthermore, the study contributes to understanding how structured physical training interventions can be incorporated into educational programs to improve specific athletic skills. From a practical perspective, the findings may provide a foundation for developing structured training programs for coaches and physical education instructors, offer evidence-based recommendations for curriculum development in coaching education, and support future investigations into long jump training methods in Indonesia. The results are expected to benefit students, coaches, physical education teachers, and researchers interested in improving athletic performance through scientifically designed training interventions.

METHOD

This study employed a true experimental method with a randomized pretest-posttest control group design. The study population consisted of all students enrolled in the PKL Department at FIKKM Unima. A total of 20 male students were selected through purposive sampling and divided into two groups: an experimental group ($n = 10$) and a control group ($n = 10$), using a split-half technique. The research design is presented as follows:

Table 1. Research Design

Groups	<i>Pre-Test</i>	<i>Treatment</i>	<i>Post-Test</i>
(R) A	Y1	X	Y2
(R) B	Y1	-	Y2

Ket: RA = Experimental group

RB = Control group

Y1 = Pre-test

Y2 = Post-test

X = Treat (Exercise)

Squat-style long jump performance was assessed using a squat-style long jump test. The experimental group underwent leg power training for eight weeks, with three training sessions per week on Mondays, Wednesdays, and Fridays. Long jump performance was measured before and after the training intervention. Each participant was given two attempts, and the longest valid jump was recorded as the final score in meters. The collected data were analyzed using univariate and bivariate statistical methods. An independent-samples t-test was conducted at a significance level of $\alpha = 0.05$, following the assessment of statistical assumptions (Paturusi, 2024).

RESULTS AND DISCUSSION

Results

This study can involve two main variables, namely the free variable in the form of leg power training or leg muscle explosiveness and the bound variable, namely the increase in the ability to long jump squat. To find out that the results of the study are the result of the variables given treatment/training, the researcher uses the control group as a controller (comparator). Based on the data score of the measurement of the variable of long jump ability in PKL FIKKM Unima students, both the data of the initial condition or pre-test and the final condition or post-test as well as the gain score/difference in the experimental group and the control group.

The following table presents the results of the measurement of the group's long jump ability in the experiment as well as the recapitulation of the numbers based on basic statistical calculations.

Table 2. Results of Long Jump Ability Test Experiment

<i>Yes</i>	<i>Pre-test (Y1)</i>	<i>Post-test (Y2)</i>	<i>Differences</i>
1	2.5	2.9	0.4
2	3.0	3.9	0.9
3	3.5	4.1	0.6
4	3.3	4.0	0.7
5	2.8	3.2	0.4
6	3.2	4.0	0.8
7	3.4	3.9	0.5
8	3.1	3.9	0.8
9	2.9	3.8	0.9
10	2.7	3.4	0.7

From Table 1. The statistical magnitude of the average value and standard deviation as well as the number of results of pre-test or initial observation (Y1) and post-test or final observation (Y2) of the explosive power of the leg muscles of the experimental group were obtained, and with the help of Camputerization of the SPSS statistical program series 26p the results were as follows;

Table 3. Descriptive Statistics Experimental

	<i>N</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Red</i>	<i>Std. Deviation</i>
Pre-test Ekps	10	2.50	3.50	3.0400	0.32042
Post-test Eksp	10	2.90	4.10	3.7100	0.40125

	N	Minimum	Maximum	Red	Std. Deviation
Gain score Eksp	10	0.40	0.90	0.6700	0.18886
Valid N (listwise)	10	-	-	-	-

Furthermore, the following is the distribution of data with the distribution of the frequency of the long jump ability score of students majoring in PKL FIKKM Unima in the experimental group with the display of data on the pre-test and post-test gain scores as a change score with the process of leg power training or leg muscle explosiveness, which can be presented in the following table.

Table 4. Difference/Gain of Experimental Group Scores

		Frequency	Percent (%)	Valid Percent	Cumulative Percent (%)
Valid	0.40	2	20.0	20.0	20.0
	0.50	1	10.0	10.0	30.0
	0.60	1	10.0	10.0	40.0
	0.70	2	20.0	20.0	60.0
	0.80	2	20.0	20.0	80.0
	0.90	2	20.0	20.0	100.0
	Total	10	100.0	100.0	-

From the distribution table, researchers can be grouped into three parts (groups), namely high, medium and low groups. The result was a difference between 0.40 - 0.50 as many as 3 students (30%) had long jump ability in the low category group, while the long jump ability score between 0.60 – 0.70 as many as 3 students (30%) were in the medium category, then for the long jump ability score between 0.80 – 0.90 as many as 4 students (40%) had long jump ability in the high category group. The explanation can be seen in the following diagram.

Furthermore, the following are presented the results of the measurement of the ability of the long jump squat style of the control group as a comparison group and the recapitulation of the numbers based on basic statistical calculations.

Table 5. Long Jump Ability Test Results Control

Yes	Pre-test (Y1)	Post-test (Y2)	Differences
1	3.1	3.4	0.3
2	2.5	2.9	0.4
3	3.3	3.7	0.3
4	3.5	4.0	0.5
5	2.9	3.1	0.2
6	3.2	3.3	0.1
7	2.7	3.0	0.3
8	3.1	3.3	0.2
9	2.8	3.4	0.4
10	3.4	4.0	0.6

From Table 4. The statistical magnitude of the average value and standard deviation as well as the number of pre-test results or initial observation (Y1) and post-test or final

observation (Y2) of the control group were obtained, and with the help of Computerization of the SPSS statistical program series 26p the results were as follows;

Table 6. Descriptive Statistics_Kelompok Control

	N	Minimum	Maximum	Red	Std. Deviation
Pre-test Control	10	2.50	3.50	3.0500	0.32059
Post-test Control	10	2.90	4.00	3.4100	0.38427
Gain-score Control	10	0.10	0.60	0.3300	0.14944
Valid N (listwise)	10	-	-	-	-

Furthermore, the following is the distribution of data with the distribution of the frequency of the long jump ability score of students majoring in the FIKKM Unima street vendor department in the control group or comparison group with the display of data on the pre-test and post-test gain scores as scores that are not given in the leg power training process, which can be presented in the following table.

Table 7. Difference/Gain of the Control Group Score

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0.10	1	10.0	10.0	10.0
	0.20	2	20.0	20.0	30.0
	0.30	3	30.0	30.0	60.0
	0.40	2	20.0	20.0	80.0
	0.50	1	10.0	10.0	90.0
	0.60	1	10.0	10.0	100.0
	Total	10	100.0	100.0	-

From table 7, the gain data of the frequency distribution score of the long jump ability score of the control group (comparison group) who were not given leg power training, the results of which can also be grouped into three parts, namely the high, medium and low group. The result was that the difference between 0.10 - 0.20 as many as 3 students (30%) had the ability to long jump were in the low group, while the score of the long jump ability was between a value of 0.30 – 0.40 as many as 5 students (50%) were in the medium group/category, then for the score of long jump ability between the value of 0.50 – 0.60 as many as 2 students (20%) were in the high group. The explanation can be seen in the following bar chart.

From the results of testing the research hypothesis using t-test statistics of two independent samples, an observation t-value of $t_{ob} = 6,247$ was obtained. Meanwhile, from the table of critical values t with a real level of $\alpha = 0.05$; $n_1 + n_2 - 2$ obtained a table t-value of $t_{tab} = 2.101$. This fact shows that the value of $t_{ob} = 6,242 > t_{tab} = 2,101$, thus the zero hypothesis (H_0) is rejected and an alternative hypothesis (H_a) is accepted which states that there is an increase in the ability to long jump squatting style in students majoring in PKL FIKKM Unima with leg power training or leg muscle explosiveness.

Discussion

After meeting the requirements of normality analysis and homogeneity test where both sample groups show homogeneous or equal variance, this means that the two sample groups before receiving different treatment have the same initial ability so that if there is or a change

is solely due to the existence of a treatment or training factor, in this case it is treatment with the approach of giving the leg muscle explosive training method.

In relation to the implementation of leg power training or leg muscle explosiveness is a model or way of presenting training materials carried out by researchers or trainers in providing leg power training directed at training to improve the ability to long jump in athletics, then the importance of the comparison group or control group. This is intended so that it is known that the initial condition or initial ability of both groups is the same in terms of long jump ability, then if it is seen that in the final condition after being given leg power training treatment in the experimental group is different from the control group, then it is assumed that this is due to the treatment of providing leg power training or leg muscle explosiveness.

The results of the investigation showed that there was a difference in the final condition or post-test of the two groups, where for the post-test value of the experimental group the scores obtained higher or better than the scores in the control group (the average experimental group $X_1 = 3,710$ while the average of the control group $X_2 = 3,410$). This shows that the leg muscle power training program given for eight weeks of training with a frequency of training three times a week can have a significant effect on improving the ability to long jump in athletics in students majoring in PKL FIKKM Unima.

In relation to muscle power training, Harsono (1998) explained that "muscular power is the ability to perform explosive movements, power is the result of maximum multiplication with the time of execution of the movement, or the ability of a person to perform maximum strength with the effort made in the shortest possible time". In another part, Suharno (1993), argues that "Explosive power is the ability of muscles to overcome load resistance with maximum strength and speed in one complete movement". In other words, strength always refers to the amount of strength of a muscle or a group of muscles in work activities. As stated by Bompa (1990), "in the training process it is nothing but to prepare athletes for the maturity of physical abilities, techniques, tactics and mentality". Given that these factors play a role in achieving maximum achievement, it is absolutely essential to prepare athletes in various sports, both physical, technical, tactical and mental, with reference to the priority scale. In this study, the priority scale of training is on the explosiveness of the leg muscles with an impact on the long jump.

CONCLUSION

Based on the findings obtained from the training intervention and statistical analysis, it was concluded that leg power training improved squat-style long jump performance among students in the PKL Department at FIKKM Unima. These findings demonstrated the positive effect of lower-limb explosive power training on long jump performance in track and field athletics.

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