

## **The Influence of Ladder Drills And Jump Rope Exercise Towards Speed, Agility, And Power of Limb Muscle**

Nanda Eriko Pratama<sup>1</sup>, Edy Mintarto<sup>2</sup>, Nining Widyah Kusnanik<sup>3</sup>  
<sup>1,2,3</sup>Surabaya State University

Corresponding Author: Nanda Eriko Pratama1

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**Abstract:** *The purpose of this study is to analyze about: (1) the influence of ladder drills exercise towards speed, liveliness, and power of limb muscle; (2) the influence of jump rope exercise towards speed, liveliness, and power of limb muscle; (3) the difference between the influence of ladder drills and rope jump exercises towards speed, agility, and power of limb muscle. This type of research uses quantitative research with quasi experimental method. The study design uses matching-only design. The subjects of the study are all of the students / athletes following extracurricular at SMAN 1 Balongpanggang Gresik as many as 30 children and divided into three groups. The experimental group I receives a ladder drills treatment. The second experiment group receives rope jump training and the third group is not treated. The data retrieval process is done by speed test with 30 m test, agility with T-test, and leg muscle power with MD jump test at pretest and posttest. As well as data analysis uses t-test and anova. The results shows that the difference between pretest and posttest of each group are: (1) experimental group I ladder drills for velocity = -0.52 sec, agility = -1.15 second, and limb muscle power = 16.48 joules. (2) Experimental group II rope jump for speed = -0.42 seconds, agility = -0.61 seconds, and limb muscle power = 31.71 joules. (3) Control group for velocity = -0.05 seconds, agility = -0.12 seconds, and limb muscle power = 2.8 joules. Based on the above analysis, it can be concluded that there is a significant influence of ladder drills and rope jump exercises towards increasing speed, agility, and limb muscle power. Ladder drills are more effective than rope jump exercises and control groups in increasing speed and agility. While rope jump exercises are more effective than ladder drills and control groups in increasing limb muscle power.*

**Keywords :** *Exercise, Ladder drills, Rope jump, Speed, Agility, Limb Muscle Power*

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### **I. Introduction**

Physical fitness can be obtained in various ways, one of them is by doing physical activity (sports). Exercise is an activity that has an influence on human daily life. It is said that because the sport is related to motion and motion itself will not be separated from human activity. Many human ways to do this activity such as walking, running, jumping, punching, and stretching that accumulates with the term motion. Motion in sports activities is motion that has a purpose. (Mylsidayu and Kurniawan, 2015, p.26) mentions that there are 4 basic objectives of human exercise: 1) sports aimed at recreation, that is done to fill the leisure time and is fun, 2) sports aimed at education, means that it is done based on the curriculum and syllabus, 3) sports aimed at physical fitness, means that it is done with a specific purpose and under the care or direction of professional personnel, 4) sports aimed at achievement, means that it is done with a careful preparation and systematic, progressive training programs, performed repeatedly and related disciplines.

Achievement in sport is a parameter for advancement in sport coaching and training. Parties involved in advancing sports achievements are the athletes, coaches, organizations and parties involved in sports coaching. It needs effort and good support both in maintaining and achieving the optimal achievement. At present, sports coaching must be based on scientific principles. Using scientific principles and appropriate training methods, quality, support and roles from different disciplines of science and technology, can spur the development of achievement in sports.

In an effort to achieve good performance in athlete's sport, must have good physical condition, because physical is the basic capital in reaching the optimal skill. Without a good physical condition of a person means that it will be difficult to run a training program, so skill will be difficult to achieve. Physical condition is one of the requirements used in achieving an achievement. To achieve peak performance in athletes, it needs physical training application programmed systematically.

Exercise is a necessity of every individual, because by exercising properly and correctly can improve physical fitness. Physical fitness is required of every individual to perform daily activities. According to

Nurhasan (2011, p.12) "physical fitness is the ability of a person's body to perform activities or daily work tasks without causing significant fatigue".

Besides fitness, physical condition plays an important role in following the exercise and on reaching an achievement. In an effort to improve the physical condition of an athlete, there are components that must be developed. According to Sukadiyanto and Muluk, (2011, p.57) that the biomotor components of sports biomotor include strength, robustness, speed, coordination, and flexibility. The other components are a combination of various components so it forms a terminology itself. Among such, power is a combination of strength and speed, agility is a combination of speed and coordination.

Components of physical condition must be owned by an athlete in an effort to optimize his/her ability in order to achieve maximum achievement. Without being supported with good physical condition, a student will be difficult to follow the exercise program well and in terms of physical fitness achievement will also be difficult to improve.

According to Sukadiyanto and Muluk, (2011, p.117) there are two kinds of velocities, namely reaction and movement velocity. Reaction velocity is the ability of a person to answer an excitatory in the shortest time. While movement velocity is the ability of a person to do motion or series of motion in time as fast as possible. Clark (2012, p.227) says speed is the ability to move the body in one direction as quickly as possible. In other words that speed is the ability to work continuous movement in the same form and in the shortest possible time.

Agility is the ability to move the direction and change the position of the body quickly, effectively, and consciously, and requires the integrity of motion skills by using a combination of balance, coordination, speed, reflex, strength, endurance, and stamina (Lin Hsiu-Ching et. ). Agility is not a single physical ability, but is composed of components of balance, coordination, speed, reflex, strength, endurance, and stamina. These components interact each other. Agility can be defined by the ability to explosively begin, reduce speed, change direction, and accelerate again quickly while maintaining body control and minimize speed reductions (Sethu, 2014, p 59). Based on some opinions above, it can be concluded that the agility is the ability to change the direction of movement as soon as possible without losing balance. Power is the main determinant of performance in activities that require a one-order movement to generate high speed when released, the act of explosive force such as muscle in throwing, jumping and reaction action (Suresh, 2016). Power is one component of physical condition that is identical with explosive power. It is one of the important factors for athletic skills, allowing them to achieve maximum kick speed when playing (Taheri, et al., 2014). Based on biomotor component chart, it consists of maximum strength components and maximum speed (Bompa, 2015, p.7). From the above explanation, power is a combination of two components of biomotor namely between maximum strength and maximum speed is done as quickly as possible and continuous.

Seeing the element of physical condition, the speed of agility and power are the element of physical condition required in many sports (Paul Gamble, 2012). For example soccer sports, martial arts, athletics, and futsal. In addition, speed, agility, and power have a very important role to increase achievement in the field of sports. In the last few years, there has been developed a very enjoyable training method using fitness equipment used in a variety of sports that resemble the ladder and serves to teach the movement skills known as Ladder Drills; form of ladder exercise that is needed to improve the speed of the foot, agility, and foot coordination for athletes. This agility ladder technique is also very popular for trainers looking for ways to improve speed, coordination, balance, and agility in athletes, (Syairulniza, p18-19). Most ladder drills are made of plastic attached to a nylon rope to form a box. Usually the box is determined about 12-18 inches (30-46 cm). The standard ladder is 10 yards long. Agility ladder is not only a tool that can be used to develop foot speed, but when it is used in a variety of ways, agility ladder can be a multipurpose tool that can also improve agility and power. Recent research has shown that ladder drills can improve speed, agility and power (Sethu, 2014, p 62). Thus, it can be concluded that ladder drills are a tool for training different patterns of foot movements through staircase exercises placed on the ground / floor where an athlete is required to jump, move right and left quickly. While the rope jump is an exercise that uses a strap tool stretching between two poles with a height of 40 cm above ground level. Rope Jump or often called jump rope is a type of physical activity that has many benefits and easy to do and practically done to get physical fitness. This exercise is an excellent form of activity to improve the ability of the physical condition because it makes the whole body move, especially those that require explosive power capabilities such as jumping, hitting, kicking, and running fast.

In doing the exercise speed, agility, and leg muscle power, variation of exercise is very much and varied, but in this study only uses two forms of exercise from the physical condition component of ladder drills Hop-Scotch Drill training and rope jump.

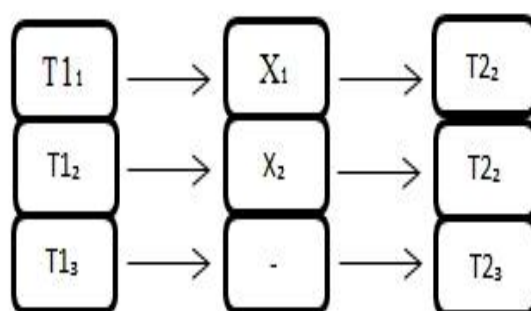
In this case, the interesting thing is the pattern of motion is almost the same, that is equally jump, but the direction of the jump is different. In the Hop-Scotch Drill pattern has heading forward and jumping with both feet into the first box then to the front of the box with legs spread apart so that every one landed outside the ladder. While in the rope jump pattern has the direction of its speed sideways, jumped by lifting both legs and thighs simultaneously to pass the rope and rested or landed with both feet simultaneously. This is an equations

of motion patterns that can be believed to improve the speed, agility, and power of limb muscle. By using a variety of simple motion patterns, it is expected in order to make trainer improving the physical fitness of athletes in terms of speed, agility, and muscle limb power so that student fitness can increase.

With the existence of media ladder drills and rope jump, the researchers want to know whether the exercise with ladder drills and rope jump training model can improve the quality of speed, agility and leg muscle power in extracurricular students SMA Negeri 1 Balongpanggung Gresik. Furthermore, this research is expected to practice with media ladder drills and rope jump used as a choice of effective and efficient exercise model in train speed, agility and leg muscle power and used as exercise options for several sports such as futsal, badminton, bolabasket, bolavoli and football.

## II. Research Methods

Type of research used is quantitative research and research method used in this research is quasi experiment research method (quasi experiment). Experimental research is a rigorous study to determine the causal relationship between variables. One of the main characteristics of experimental research is the treatment imposed on the subject or object of research. Design in the study is Non-Randomize Control Group Pretest-Posttest Design (Maksum, 2012, p.100). The study design is described as follows:



Picture 3.1. Research Design (Maksum, 2012, p. 100)

### Information :

T1<sub>1</sub>: Group 1 pretest speed, agility and leg muscle power

T1<sub>2</sub>: Group 2 pretest speed, agility and leg muscle power

T1<sub>3</sub>: Group 3 pretest speed, agility and leg muscle power

X<sub>1</sub>: Ladder drills

X<sub>2</sub>: Rope jump exercise

T2<sub>1</sub>: Group 1 posttest speed, agility and leg muscle power

T2<sub>2</sub>: Group 1 posttest speed, agility and leg muscle power

T2<sub>3</sub>: Group 1 posttest speed, agility and leg muscle power

In quantitative research, the population is a generalization region consisting of: object / subject that has a certain quantity and certain characteristics applied by the researcher. Population is the most important part in doing research because the population is used as a source to obtain data in research. The population in this study are all male students of SMAN 1 Balongpanggung Gresik class X-XII who followed extracurricular as many as 30 students. Being a population in this study are students who have the following characteristics:

- Registered as a student of SMAN 1 Balongpanggung Gresik.
- Male sex.
- Having age 15-17 years.
- Following extracurricular activities at school.

## III. Data Collection Technique

The types of data collected in this study are the speed, agility, and leg muscle power tests of both types of exercises in each group. Then, the test results will be recorded and calculated based on the group and type of exercises applied. Data analysis uses descriptive statistical techniques and analyzed by the help of SPSS (Statistical Program For Social Science) version 21.0.

### A. Data Prerequisite Test

#### 1. Data Normality Test

The data normality test aims to ensure that the data obtained is normally distributed. To test the normality uses the Kolmogorov-Smirnov method. To determine whether or not the normal distribution of data is

by comparing the level of significance of data calculation with 5% level. If the level of significance in the statistical test is greater than 0.05, so the data is normally distributed. By calculation formula:

$$X^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

**2. Homogeneity Test**

Homogeneity tests aims to ensure that the variants of each group are the same or the like, so the comparison can be done fairly. This study uses lavene's test. If the statistical value is greater than 0.05, so the data has a homogeneous variant. By calculation formula:

$$S_{X^2} = \sqrt{\frac{n \cdot \sum X^2 - (\sum X)^2}{n(n-1)}} \quad S_{Y^2} = \sqrt{\frac{n \cdot \sum Y^2 - (\sum Y)^2}{n(n-1)}}$$

**3. Hypothesis Test**

- a. In accordance with the hypothesis and type of research used in this study, the statistical analysis used to determine whether there is a comparison of the effect of ladder drills and rope jump exercises on increasing the velocity, agility and leg muscle power is a paired sample test by using rejection of the hypothesis at  $\alpha = 0.05$ .
- b. To know the difference of big effect towards increase of dependent variable before and after treatment between group, it is used ANOVA statistic analysis (Analysis of Variance), with level of rejection of hypothesis at  $\alpha = 0,05$ .
- c. To know which independent variables having the most influence in increasing dependent variable, it is used LSD (Least Significant Different) statistical analysis in SPSS program series 21.0, with the level of rejection of hypothesis at  $\alpha = 0,05$ . By calculation formula:
- d.

$$t = \frac{x_1 - x_2}{\sqrt{S_p^2 \left( \frac{1}{n_1} + \frac{1}{n_2} \right)}} \quad S_p^2 = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}$$

**B. Hypotheses Test Requirements**

1. Normality test

Variabel	Test	Kel. I	Kel. II	Kel. III	Ket	Status
		Sig	Sig	Sig		
Kecepatan	Tes Awal	0.978	0.989	0.976	P > 0,05	Normal
	Tes Akhir	0.987	0.980	0.896	P > 0,05	
Kelincuhan	Tes Awal	0.887	0.558	0.984	P > 0,05	Normal
	Tes Akhir	0.746	0.583	0.834	P > 0,05	
Power tungkai	Tes Awal	0.994	0.538	0.996	P > 0,05	Normal
	Tes Akhir	0.993	0.478	0.997	P > 0,05	

Based on the above table shows that the data acquisition of the three dependent variables namely speed, agility and power limbs have the meaning that the data is normally distributed. This is because the significance (p) of each group shows (p) or sig > 0.05 which results in H0 being accepted. Thus, it can be concluded that the data is taken from the population that normally distributed.

2. Homogeneity Data Test

Variabel	Test	Sig (P)	Ket	Status
Kecepatan	pretest	0.866	P > 0,05	Homogen
	posttest	0.892	P > 0,05	Homogen
Kelincahan	pretest	0.925	P > 0,05	Homogen
	posttest	0.792	P > 0,05	Homogen
Power Tungkai	pretest	0.055	P > 0,05	Homogen
	posttest	0.051	P > 0,05	Homogen

Based on the above table 4.7 shows that the data acquisition of the three dependent variables namely speed, agility and limb power have homogeneous variance. This is interpreted because the significance value of each data shows the level of significance or (p) > 0.05. Thus, it can be concluded that the variance in each group is the same or homogeneous.

3. Different Post Hoc Test with LSD Speed, Agility, and Limb Muscle Power

**ANOVA**

		Sum of Squares	df	Mean Square	F	Sig.
KECPRE	Between Groups	0.011	2	0.005	0.049	0.000
	Within Groups	2.966	27	0.110		
	Total	2.977	29			
KECPOST	Between Groups	0.589	2	0.294	2.848	0.005
	Within Groups	2.791	27	0.103		
	Total	3.380	29			
KELPRE	Between Groups	0.136	2	0.068	0.203	0.000
	Within Groups	9.037	27	0.335		
	Total	9.174	29			
KELPOST	Between Groups	5.260	2	2.630	6.429	0.005
	Within Groups	11.045	27	0.409		
	Total	16.306	29			
POWPRE	Between Groups	5597.820	2	2798.910	0.703	0.000
	Within Groups	107462.556	27	3980.095		
	Total	113060.376	29			
POWPOS	Between Groups	6506.707	2	3253.353	0.893	0.005
	Within Groups	98317.702	27	3641.396		
	Total	104824.409	29			

Based on the results of Pos Hoc Test with Lsd, dependent between groups of dependent variables (speed, agility, and imb power), it can be concluded that there is a significant effect of ladder drills and rope jump exercise on increasing speed, agility, and leg muscle power. Ladder drills are more effective than rope jump exercises and control groups in increasing speed and agility. While rope jump exercises are more effective than ladder drills and control groups in improving leg muscle power.

#### **IV. Results And Discussion**

##### **A. Group I Training Ladder Drills (Hop-Scotch Drill)**

Ladder drills is a form of jumping exercise by a foot or two by jumping on a ladder-shaped rope that is placed on the floor or on the ground. This exercise cannot be separated from leg muscle strength because it uses a lot of leg muscles in addition to using leg muscles only. The main muscle components involved in the Ladder Drills are Sartorius muscle, Gracilis muscle, Semitendinosus muscle, Gluteus Maximus muscle, Vastus Lateralis muscle, Vastus Medialis Muscles, Vastus Intermedius Muscles, Gastrocnemius Muscles, Longus Peroneus Muscles, Hallucis Longus Muscle Extensor, and Hallucis Longus Flexor Muscles. Ladder drills exercise helps us to improve movement aspects, increase balance, muscle power coordination and reaction time between all of body parts and to change direction quickly for players even at high speed. Besides physical benefits, using this tool can also improve the nerve system and related muscle groups.

Ladder drills exercise has a significant effect on speed and agility because the leg muscles constantly perform contractions continuously during the exercise. Ladder drills in ladder practice The Hop-Scotch Drill begins with one leg on each side of the ladder. Then, the players jump with both feet into the first box then to the front of the box with legs spread apart so that every one landed on the outside of the ladder. Ladder Hop-Scotch Drill training data provides a significant increase in speed and agility. After the significance test, it can be said that the giving of the Hop-Scotch Drill training really has a positive effect on the increase of speed and agility. These results provide concrete evidence that the practice of Hop-Scotch Drill is one of the exercises using speed and agility increasing that can more influence towards male students of extracurricular SMAN 1 Balongpanggang Gresik. Performance at the speed and agility of the Hop-Scotch Drill training group increases from each group after doing pretest to posttest. These findings are the same as Thomas B. Walker's and Lynette Lenneman's (2010), M. Prabhakar's and G. Sokkanathan's (2016) studies in their journals' conclusions that the foot ladder drill training group shows significant improvements in speed and agility. It is also the same as Syarulniza's, Nurhani Aziz's & Lim Boon Hooi's research result (2015) reports that ladder drill can improve speed and agility performance.

##### **B. Group Exercise II Rope Jump**

Rope jump is a training by using a rope media tied to two poles as high as 40 cm. The athletes stand next to the rope with the position of the foot opened shoulder width apart. Then, they jump the rope to the right and left by lifting both legs and thighs simultaneously and resting or landing on both legs simultaneously. This exercise is done continuously. The major muscle components involved in rope jump exercises are muscles: Tensor Fasciata muscle, Abductor muscle, Vastus Laterae muscle, Retus Femoris muscle, Sartorius muscle, Vastus Medialis muscle, Gluteus Maximus muscle, Tibialis Anterior muscle, Extensor Muscle Long Digitorum, Gastrocnemius Muscle, Muscle Tendon Achilles, Soleus Muscles, Maleolus Medial Muscles, and Retinacular Muscles. Rope jump exercises have a significant influence on leg muscle power because the limbs constantly perform continuous contractions while performing the exercise. In plyometric exercise, there are two elements of motion related to the muscles; eccentric and concentric movement.

*Eccentric actions, which occur when the muscle lengthens under tensions, are used to decelerate the body. Eccentric muscle actions are primarily associated with the loading phase of a plyometric exercise. For example, in a runner's stride, the impact of contacting the ground on a single foot requires the body center of gravity to drop rapidly. The runner does not collapse at this moment because the leg muscles can respond with eccentric muscle actions that slows and control this lowering motion. Eccentric muscle absorb force and decelerate the joint segment in preparation for the transition into isometric and, ultimately, concentric muscle action. Because eccentric muscle action is capable of generating up to 40 percent greater force than the other types of muscle action, the performance in many sports (Chu & Myer, 2013:chapter 1).*

From the statement above, according to Chu & Myer (2013) eccentric movement is a movement that occurs when the muscle is stretching and there is slowing of body movement. The eccentric movement of muscle is related to the final phase of plyometric exercise; for example, for the runner, when the foot rests on the ground, with one leg next resting on the ground. In this movement, the runner does not lose balance because the leg muscles can respond with the action of eccentric muscles ing slow down and controlling the landing movement. The eccentric movement creates a force and slows the joints in the transition process which ultimately continues in the concentric movement. It is because the action of eccentric muscles can generate power up to 40 percent greater than other types of muscle action, in most sports.

Exercise data show that rope jump exercises have a great effect on increasing leg muscle power. After the significance test, it can be said that giving rope jump exercise really has a positive effect on leg muscle power. These results provide concrete evidence that rope jump exercise is one of the exercises with a focus on increasing limb muscle muscle having a greater effect on male students of extracurricular SMAN 1 Balongpanggang Gresik.

Performance on the limb muscle power of the rope jump training group increases from each groups after doing pretest to posttest. This finding is the same as the study of Aalizadeh A, et al (2015) who states in his research that short-term plyometric exercise can improve sprint, strength, power, and agility. That statement is also the same as the results of Mannan's (2015) study which states that plyometric exercise significantly improves speed, power, and agility.

## V. Conclusions And Suggestions

### A. Conclusion

Based on the results of research and discussion that have been described in the previous chapter, it can be concluded as follows:

1. There is a significant effect of the drill Hop-Scotch Drill ladder drill towards the speed, agility, and leg muscle power.
2. There is a significant effect of rope jump exercise on speed, agility, and leg muscle power.
3. There is a different effect between the Hop-Scotch Drill practice and the rope jump on the speed, agility, and leg muscle power. The Hop-Scotch Drill exercise has a better effect than rope jump training to improve speed and agility. Furthermore, rope jump exercises give a better effect compared to the giving practice of Hop-Scotch Drill to increase leg muscle power.

### B. Suggestions

1. This research needs further research on plyometric exercises especially ladder drills Hop-Scotch Drill and rope jump with different sample conditions.
2. For the trainers, in order to prepare the training program, they must pay attention to the characteristics of each athlete's ability, so the athlete is able to carry out the training program, and the training process can be run smoothly and get the maximum result.
3. The Hop-Scotch Drill and rope jump ladder drills practice method can be recommended and applied in an exercise program to improve the speed, agility, and muscle power of the limbs.
4. For further researchers, it can be used as input and comparison of research results if choosing similar problems as the object of the researcher

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