

Influence of Ballistic Weight Training and Ballistic Functional Training to the Increase of Strength, Speed, Agility and Power on Lower Extremity Body

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Abstract: The research method was quasi-experimental research, using randomized pretest-posttest design. The results showed that there was a significant effect of leg press and squat exercises easy power station to the improvement of ladder drill to increase strength, speed, agility, and power. There are differences in the effect of two models of exercises on strength, speed, agility, and power. Model leg press and squat exercises easy power station improved further on the strength, speed, and power, while the model of cherry pickers ladder drill exercises and 180s worked more on agility. There was a significant effect of exercises on leg press and squat easy power station to increase the strength of 15.8182 kg, a speed of 0.1318 seconds, agility of 0.9091 times, and a power of 12.6 watts. There was a significant effect of exercises on cherry pickers and 180s ladder drill to increase the strength of 8.4545 kg, speed of -.5046 seconds, the agility of 4.0909 times, and a power of 5.9364. Model leg press and squat exercises easy power station was more effective in increasing the strength of 7.3637 kg, a speed of 0.3728 seconds, and a power of 6.6636 watts. The model of cherry pickers ladder drill exercises and 180s ladder drill were more effective than the model of leg press and squat exercises easy power station in significantly increasing agility and speed of 4.0909 times by - 0.5046 seconds. Exercise leg press and squat exercises easy power station with cherry pickers and 180s ladder drill had very significant effect in increasing the strength of 12.1364 kg, speed of -0.3182 seconds, agility by 2.5 times and power of 5.9364 watts.

1 INTRODUCTION

In the modern sport era, to improve the skills and performance in modern sports, everyone has to prepare themselves through a series of training processes and target the physiological aspects of the body to improve its ability and optimize performance for the body's needs. "An athlete's high performance in a game is achieved through training designed to enhance the automation ability of motor skills and enhance the structural and functional abilities of the body's metabolism" (David, 2011). And "the purpose of the training is to improve the ability and endurance of the power aspect (ability to sustain the highest power) or increase the speed of movement from time constraint or a distance travelled by the athlete" (Hawley, 2009).

Exercises conducted here aim to improve the performance of an athlete and to increase the power capability in addition to an increase of speed through movements that are managed with time. These

movements are intended to gain endurance so that an athlete will always be ready to perform. This cannot be separated from the coaching system.

The element of physical ability according to Bompa and Halff (2009) "is very important because it is indispensable in improving sporting achievement, in which the elements include strength, speed, elucidation, muscle explosive power, agility, precision, balance, endurance of heart and lungs muscles and coordination."

Before determining the type of exercise required for this study, the characteristics of movement and the type of muscle that is contracted to produce agility and power must be understood first. Chu and Myer (2013) suggest that "a movement that begins with eccentric action and later followed by a moment when muscles have contraction isometrically which will be continued by a concentric movement, is a movement that can always increase power. As for the contracting muscle, it depends on the type of movement performed."

In this researcher, the writers only see the two very important physical components, namely the agility and power, because the two components already include some other components, for example long jump motion includes the combination of power with speed causing power or explosive power. Power according to Woodrup (2009) "is a combination of two elements of physical condition, namely the forces of contraction and speed of motion performed simultaneously."

One of the tools that has been created for training in increasing strength, speed, agility and power is the agility ladder, and a wide variety of movements has been created using such tool. The hope from creating tools with a variety of movements is to be able to provide various kinds of training. Training by using kinetic tool has many variations and can do various movement combinations, so it is very useful for dynamic sports.

Agility ladder training also has many types of movement with the aim of improving the agility and power. "One of the principles of movement that can use the agility ladder tool is plyometric movement. Research with a plyometric training program with a significant improvement ($p < \alpha 0,01$) on agility and power has recommended that giving plyometric training for six weeks can improve the agility and power (Michael G. Miller, 2006). These trainings will help the performance of an athlete so that he or she can be ready for the competition.

Generally, there are two categories of athletes competing in elite competition, the first is for athletes who are genetically talented in certain branch of sport, and the second is for athletes who develop through a training process with a well-guided and well-run system "(David, 2011). In enhancing the physical capacity and abilities of an athlete, trainers need to know the basic skills and specific abilities of a sport. "The basic capabilities in question are the physical components (fitness components) consisting of motor skills or motor performance, fitness or physical fitness and health-related physical fitness" (Pate, 2003). Among the various components, the aspects of strength, speed, agility and power support an athlete's achievement.

Strength and speed are the most dominant aspects of every sport. The definition of "strength as the ability to extract energy derived from skeletal muscle" (Kraemer, 2008) becomes the most fundamental aspect of all fitness components along with heart and lung capabilities. Speed is defined "as the distance divided by time, given by units of meters per second. But in the definition of sport performance, this sense is reversed. Speed is the time it takes to travel a certain distance".

The involvement of strength aspect on the increase of speed is dominant. This is caused by the

fact that in developing the speed, aspects such as maximal force capacity, the rate of force development ratio and the concentric-eccentric ability of muscle contraction (stretch-shortening cycle ability) become the most important predictors of an athlete's pace determinant". So, the researchers felt that strength and velocity are interconnected with one another.

Furthermore, there are aspects of agility and power which become the aspects of development and is a combination of some basic components that are important in sport performance. Power, as it is known in general, has a working ratio between product of force and velocity. Athletes who want to get a big power must have the ability to release a large force and have the ability to have contraction quickly too (Kawamori, 2010).

On the other hand, agility is a physical component that requires development in many aspects. The agility component requires not only the physical aspect, but also the cognitive aspects used to improve reaction time, anticipate, and know the situation of the match and the decision of the movement. The short definition of "agility is" CODS "or Change-of-Direction Speed". In a motion that is typically fast and changes direction, there must be an acceleration phase, then deceleration, change of direction, and then acceleration.

There are various types of training developed due to the many effects produced and time efficiency. One of which is training with ballistic movements. The basic concept of this training is more on the movement of stretch-shortening cycle ability that is fast so as to increase the maximal force capacity and rate of force development. Ballistic training is said, in several theoretical studies to improve the rate of force development and post activation potentiation. The definition of the rate of force development is the ratio of energy spent during physical activity with a certain time "(McBride, 2010).

Another definition of rate of force development is explosive muscle strength in both isometric, concentric and eccentric contractions. Meanwhile, the definition of post activation potentiation is an acute increase in muscle capacity as a result of muscle contractions." (Robbins, 2005) In ballistic training there are several trainings that incorporate typical movements such as training on weight training with adjustments to the principle of ballistic movement and ballistic exercise exercises themselves are functional movements, due to elements of physical components such as strength, speed, agility and power is related to each other, and the need for a training model that can accommodate all these components in one form of training, whereas the definition of the physical component's

ability is more focused on the lower extremity body's ability, hence the researchers are interested to compare one form of weight training with ballistic movement and training of functional movements with ballistic movement. Functional movement training will be assisted by ladder drill tool with cherry pickers ladder drill and 180s ladder drill and weight training with ballistic movement using leg press tools and power station equipment.

2 METHODS

2.1 Types of Research

In accordance with the problems and research objectives that have been described previously, then the type of research used is quasi experimental research (quasi experiment), using quantitative research approach (quantitative research). The design in this research is using experimental research (experimental design). In the experimental study here provides treatment in the form of leg press training and easy power station squat and training cherry pickers ladder drill and 180s ladder drill.

2.2 Research design

This research uses quantitative approach with experimental research type. The research design used in this study refers to the formulation of problem/objectives of research include: to group pre-test post-test design.

2.3 Research population and sample

Population in this research is a set of students of education force student of 2014 Universitas Negeri Surabaya with details as in Table 2 below:

Table 2: Details of Research Subject Data.

Class	Σ Student	Men
A	43	38
B	39	32
C	39	31
D	43	37
Total	164	138

Of the 164 students, the number of female students was reduced by 26 students to 138 students, followed by 138 students after identification, there were some students who were not used because of illness, attending outside training so that there were 124 students.

Furthermore, 124 students were given a lottery and there were 22 students determined as members of the sample. Because the 124 students who made the population were of similar in aspects of age, weight, and height, the population can be categorized as a relatively homogeneous population. Furthermore, to determine group I and group II, there was a rating process for pre-test results which was followed by Ordinal Pairing (OP) that ultimately generated 11 members of the sample for group I and members of the sample for group II.

2.4 Data collection instruments

To answer the research questions, the data required in this research are data about the strength, speed, agility, and power of each member of the sample. Data collection before treatment (pre-test) and after treatment (post-test) in SSFC UNESA. The test data collection tool in question are:

The Limb Muscle Strength Test, measured by leg dynamometer with kilogram (kg). The test was implemented three times.

The Speed Test, measured by a tool called *Stop Watch* with time unit (seconds).

The Agility Test, measured by a device called Side Step Test. The test results were seen on the monitor with the "multiplication" unit (Sport Science and Fitness Center Unesa).

Power Test, Force Plate/Accu Power Test. The test was implemented three times, in which the best result will be used as data.

2.5 Data collection process

In conducting the process of data collection, researchers did as follows:

- a. First, to conduct the orientation process for a smooth implementation of research, especially in the process of data collection. The researchers must establish about the adequacy of the number of respondents. Next was the gathering of students of Education Unemployment Training program, UNESA batch 2014, especially male. Overall, there were 124 male students, from which the size of the sample for research became 2 groups of 11 students each. So, the number was 22 students. It was based on the sample formula Joan Welkowitz, et al (1971: 195) as follows:

$$N = \frac{\delta}{\gamma} + 1 = \left(\frac{\delta}{P_1} \right)^2 + 1 \quad (1)$$

$$\delta = \text{delta} = 3 \text{ poweranalysislabel}$$

0.85 with significant of 0.05
 N = sample size
 $\gamma = P_1 (\text{effectsize, gamma}) =$
 0,05 (α ; 0,05) \rightarrow treatment research.
 N calculation:

$$N = P_1 \left(\frac{3.00}{0.05} \right)^2 + 1$$

$$N = 37$$

Based on the calculation above, there were 37 students, but only 22 students needed. So, it was necessary to draw which students who were assigned as sample. After the draw, there was found 11 students for each group. The process of selecting samples to determine who will be sampled using simple random sampling method.

- b. Second, giving statement letters to the samples, and then the researchers conducted initial tests with three measurements for strength, speed, agility, and power. Implementation of random sample process was to place the sample in each group.
- c. Third, the implementation of maximal repetition of each experimental group, including the implementation of maximum repetition of *leg press* and *cherry pickers ladder drill* on group I, *easy power station squats* and *180s ladder drill* on group II.
- d. Fourth, the processing of the maximum repetition data that will be made into reference program in increasing the intensity, repetition, set, and interval in the exercise.
- e. Fifth, after 2 months ended, a final test data is collected from all experimental groups.
- f. Sixth, after that, the researchers did data processing in accordance with predefined data analysis techniques using *SPSS 20* assistance.

2.6 Data Analysis Technique

Data analysis in the study used *SPSS 20* program with 5% significant level. Before reaching the stage of data analysis, there was mean data processing first to find the average in the results of research. Such process was continued by prerequisite test consisting of normality test and homogeneity test.

The data normality test used Shapiro-Wilk test with 5% significant level. If the significance level in the Shapiro-Wilk test is greater than 0.05 then the data are declared to be normally distributed. The homogeneity test of covariance is done to know whether the collected data are homogenous or not by

using the Box's Test of Equality of Covariance Matrices. If the statistic value of homogeneity of variances is greater than 0.05, then the data have homogeneous covariance.

After the prerequisite test is met, then the process was continued with hypothesis testing. To test the research hypothesis, the researchers used paired t test technique and multivariate analysis of variance (Manova) by using the assistance of *SPSS 20* program.

Activities of each group during the study:

Group I, during the research activities, the respondents of group I did leg press training and cherry pickers ladder drill according to the training program provided every Monday, Wednesday, and Friday.

Group II, during the research activities, the respondents of group II did *train leg squats easy power station* and *180s ladder drill* according to training program provided every Monday, Wednesday and Friday.

3 RESULTS AND DISCUSSION

The results of this study were taken from the previous calculation by using the same procedure as data analysis technique that has been determined. The analysis of the research results is then related to the hypothesis of the study as described in the previous chapter. In this chapter, we will describe the description of the data, the hypothesis test requirements, and the results of the hypothesis testing. Description of the data will be elaborated in the form of measurement data of strength, speed, agility, and power before and after the treatments were given to each group.

The result of descriptive analysis of research data from Group I, which is the group that is treated with leg press and squat easy power station model, can be seen in table 3 below:

Table 3: Data on results of leg press training and easy power station squat.

Subject Number	Delta			
	Strength	Speed	Agility	Power
1	16,5	-,08	1,00	11,00
2	18,5	-,12	2,00	15,50
3	13	11	3,00	3,20
4	14,5	-,22	-,00	4,70
5	11	-,10	3	13,8
6	15	-,40	2	12
7	24	-,24	-1,00	25
8	12	,10	-3,00	17,9

9	20	,20	,00	9,3
10	17,5	-,40	2	14,2
11	12	-,30	1	12
Mean	15,818	-,1318	0,9091	12,6
SD	3,9703	,2044	1,8141	5,9933

From the table above, it is shown that the training with leg press model and easy power station squat can increase strength, speed, agility, and power respectively as big as 15.8182 kg, -, 1318 seconds, 0.9091 times, and 12 , 6 watts, with raw intersections respectively 3.9703 kg,, 2044 seconds, 1.8141 times, and 5.9933 watts. These results apply only to group I samples only.

The result of descriptive analysis of research data from Group II, which is the group that is treated with cherry pskers ladder drill and 180s ladder drill, can be seen in table 4 below:

Table 4: Data on results of increased strength, speed, agility, and *power* for group II.

Subject Number	Delta			
	Strength	Speed	Agility	Power
1	7,00	-,25	6,00	4,00
2	11,50	-,50	5,00	6,00
3	8,00	-,24	3,00	3,00
4	6,00	-,80	2,00	6,60
5	12,00	-,60	4,00	7,60
6	9,00	-,44	2,00	9,00
7	5,00	-,60	5,00	5,00
8	8,00	-,60	6,00	5,20
9	9,00	-,80	3,00	8,30
10	10,00	-,50	4,00	3,60
11	7,50	-,22	5,00	7,00
Mean	8,454	-,504	4,09	5,936
SD	2,150	,2054	1,44	1,964

From the table above, it appears that cherry pickers ladder drill and 180s ladder drill models can increase strength, speed, agility, and power respectively by 8.4545 kg, 0.504 seconds, 4,0910 times, and 5.9364 watts with standard deviations respectively 2.1501 kg, 2054 seconds, 1.4460 times, and 1.9640. These results apply only to group II samples only.

4 CONCLUSIONS

In this research, we get the following conclusions:

Leg press exercises and easy power station squats have significant effect on the strength increase of 15.8182 kg, the speed of -0.1318 seconds, agility of 0.9091 times, and power of

12.6000 watts for sports education coaching students, The results of this study show that more effective training to improve strength, speed, and power can be done using the leg press and squat easy power station training model.

For coaches who want to improve speed and agility effectively, it can be done by using the cherry pickers ladder drill and 180s ladder drill and with the help of kinesis tool. This training model is very effective to improve the agility.

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