

The effect of plyometric training on the sand and the land to football players power of the leg

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Abstract:

The objective of this study was to obtain information about the effect of plyometric training on the sand and the land to football players power of the leg. It employed an experimental method with a 2 x 2 factorial design. The study population consisted of 30 football players. The total research sample was 16 players. The data collection techniques involve sprint tests and vertical jump tests. In this study, the subjects were taken using purposive sampling technique. Sampling with purposive sampling based on criteria or conditions, and has a specific purpose. The results of the study shows that. (1) There was a significant difference effect between plyometric training on the sand and the land to increase the lower leg power of the football players. The plyometric training methods on the sand was higher (good) with a mean value posttest of 7.125 compared to that on the land with a mean value posttest of 6.00. (2). There was a significant difference effect between players who have high speed and low speed with a mean value posttest of 55,625 better than low speed players with a mean value posttest of 53,625. (3) There was no significant interaction between the training methods (plyometric on the sand and the land) and speed (high and low) to increase the football players power of the leg. The results of the study concluded that (1) The plyometric training methods on the sand was more effective than the those on the land. (2) Players with high speed may obtain higher results was than those with low speed.

Key Words: plyometric, leg power, speed, sand, land

Introduction

Sport is a systematic activity that is useful for developing physical, spiritual, and mental (Law no 3 of 2005). In addition, the Law also contains the objectives of national sports which reads "National sports aims to maintain and improve health and fitness, achievement, human quality, instill moral values and noble character, sportsmanship, discipline, strengthen and foster national unity, strengthen national resilience, and elevate the dignity, dignity and honor of the nation." The objectives of national sports are divided into 3 scopes including education, recreation and achievement.

Educational sports are physical education and sports that are carried out as part of a regular and sustainable educational process to gain knowledge, personality, skills, health, and physical fitness. Recreational sports are sports that are carried out by the community with a passion and ability that grows and develops in accordance with the conditions and cultural values of the local community for health, fitness, and joy. Achievement sports are sports that foster and develop sportsmen in a planned, tiered, and sustainable manner through competition to achieve achievements with the support of sports science and technology (Law of the Republic of Indonesia No. 3 of 2005 concerning the national sports system article 1 paragraph 13). Sports achievement intended here is an effort to improve the ability and self-potential of sportsmen in order to improve the dignity and dignity of the nation in order to achieve achievements.

Sports achievement is developed through special coaching in an organization in the form of a club that is only concerned with one sport, so that the coaching carried out can focus on the achievements of the sport. Because coaching focuses on achievement, the training program and activities carried out in the club must be aimed at achievement, so that all activities carried out are well programmed.

At this time, one sport that has many clubs is soccer. Most every region must have a soccer club or soccer school. However, coaching towards achievement is not necessarily understood by all leaders and coaches in all soccer clubs. Because in the game of soccer there are several important factors that must be mastered by soccer players including physical, technical, tactical, and mental. These four factors are very important to support the skills of playing soccer. One of the important factors in a soccer game is physical factors. Where physical factors will always be active during match activities, so that almost all organs of the footballer's body will always move in a soccer game starting from the head, body, to the feet. Thus, it is no exaggeration that physical factors are dominant in soccer games.

Supporting the skills of soccer players in performing their performance, one of which is supported by the power of the soccer player's limbs themselves. Soccer games are more dominant in the muscles in the legs. In addition to the need to kick the ball, leg power is also needed by soccer players to run, when in attack or defense

positions. Based on my observations of PERSIKUP Kulon Progo soccer players while competing, it can be seen that some players are still often left behind when trying to grab the ball both during the struggle for the lower ball and the upper ball, players still often lose in the struggle for the upper ball. This can indicate that an athlete's leg power is still weak and needs to get more appropriate training. This is because if the leg power of a soccer player is weak, then the athlete will not be able to perform well. Apart from the results of my observations, other observations, namely by asking directly to the PERSIKUP Kulon Progo soccer coach, found that the coach has not provided special training for his players' leg power.

Therefore, increasing leg power really needs to be considered by the ranks of coaches, so that it can improve the ability to play soccer for their fostered athletes. Bompa (1999: 3) explains that strength and speed training are important factors to increase an athlete's power. Power is one of the important components in a soccer game. One form of exercise that can increase leg power through weight training, and pliometric exercises. Pliometric exercises are exercises that combine speed training and strength training to produce explosive movements or fast and strong movements.

Pliometric training as an excellent exercise to increase leg power. Pliometric exercises are of great benefit to soccer players. There are several forms of plyometric exercises that can increase explosive power by dividing training to improve legs and hips (Bound, Hop, Jump, Leap, Skips and Ricochets), trunk (kicks, swings, spins), flexion and extension and upper body by pressing, swinging, and throwing (Radcliffe and Farentinos, 1958: 109). The forms of plyometric training are grouped into two, namely low intensity exercises, and high intensity exercises. Low intensity exercises include: 1) Skipping, 2) Jumping rope, 3) Low jump with short steps, 4) Jumping and Jumping, 5) Jumping with a height of 25-35 cm over ropes and benches, 6) Throwing a small ball, and 7) Throwing a medicine ball weighing 2-4 kg. High-intensity exercises include: 1) Long jump with no start, 2) Triple jump, 3) High jump with long steps, 4) Jump and skip, 5) 35cm high jump on a bench, 6) Throwing a 5-6 kg medicine ball, 7) Reactive and drop jump, 8) Throw balls or heavy objects.

The most important principle in pliometric training is that players must have a good base of speed and strength with the correct technique. Power is the ability of muscles to exert maximum strength in a very fast time (Astuti, 2014: 3). Speed has 2 types, including reaction speed and speed of movement (Sukadiyanto, 2002: 109). Reaction speed is the ability of people to respond to emotions with a fast duration of time. In the reaction rate there are individual reactions and compound reactions. Movement speed is an effort made by people to make movements with a very fast time duration. There are various kinds of speed, namely running speed, response speed, and movement speed (Suharno, 1993: 47). Speed is one of the elements that is strongly influenced by leg muscle power to be able to produce maximum performance. A person's level of speed determines or can indicate the leg power of a soccer player when performing skills or when playing soccer.

In playing the ball using pliometric exercises can be effective if the coach provides the right training so that it is beneficial to the player. This is because practicing intensively is not enough to guarantee the achievement of this increase in achievement because increased achievement is achieved if in addition to intensive, quality and quality training is carried out (Tohar 2002: 10). Based on this description, this research aims to improve the soccer playing skills of athletes in soccer clubs and football schools. This is realized in the form of scientific research entitled "The difference in the effect of pliometric training on the sand and the land and speed on the leg power of PERSIKUP Kulon Progo soccer players".

Material & methods

Research Type and Design

This research was conducted in the soccer team of Persatuan Sepak Bola Indonesia Kulon Progo (PERSIKUP). This type of research is experimental research. The research method used in this study is using a 2 x 2 factorial design, which is a factorial experiment involving two factors, each factor consisting of two levels, using an initial test (pre-test) and a final test (post-test). The experimental research was divided into 2 groups, namely the pliometric group in the sand and pliometric on the land.

Table 1. Research Design Framework with 2x2 Factorial

Running Speed (B)	Manipulative Variable	Metode Latihan (A)	
	Attribute Variable	Pliometric exercises on the sand (a ₁)	Pliometric exercises on the land (a ₂)
	High speed (b ₁)	a ₁ b ₁	a ₂ b ₁
	Low speed (b ₂)	a ₁ b ₂	a ₂ b ₂

Based on the table, a₁b₁ is the group of players with high speed trained with pliometric exercises on the sand, a₂b₁ group is the group of players with low speed trained with pliometric exercises on the sand, a₁b₂ group is the group of players with high speed trained with pliometric exercises on the land, and a₂b₂ group is the group of players with low speed trained with pliometric exercises on the land.

Population and Research Sample

Population is an object and subject that has certain characteristics that are used for research and then conclusions will be drawn (Sugiyono, 2013: 80). The population in this study were all 30 PERSIKUP Kulon

Progo soccer players. Sugiyono (2013: 81) explains that the sample is part of the number and characteristics of the population. In this study, the subjects were taken using purposive sampling technique. Sampling with purposive sampling based on criteria or conditions, and has a specific purpose.

Research Variables

The variables in this study consisted of 2 independent variables and one dependent variable. Independent variables include 1) Manipulative variables are pliometric exercises on the sand and pliometric exercises on the land. 2) Attributive variables are high and low running speed. The dependent variable is leg power.

To avoid other meanings of each research variable, it is necessary to state the operational definitions of the variables studied as follows: 1) Speed in this study is the ability of PERSIKUP Kulon Progo players to run 60 meters quickly which is taken in seconds. 2) Pliometrics in this study used variations between single leg bound and double leg bound performed in sand and on the land. 3) The power test instrument in this study uses a vertical power jump test instrument.

Data Collection Techniques and Instruments

To obtain the data needed in this study, there was a measurement test consisting of a running speed test and also a leg power test. For the running speed test instrument using the 60 meter speed test instrument (Ismaryanti, 2006: 58) with a validity of 0.72 and a reliability of 0.92, while for the power test instrument using the vertical power jump test instrument (Atmojo, 2013: 73) with a reliability value of 0.977 and a validity of 0.989.

Data Analysis Technique

The data analysis technique used in this study is a two-way analysis of variance (ANOVA), but before the variance analysis is carried out, the prerequisite test consists of normality test and homogeneity test. Data normality testing is a data test that aims to determine the distribution of data as a prerequisite for parametric statistical tests. In addition, this normality test is carried out to determine whether the data has a normally distributed distribution to test the normality of the data in this study using the Lillefors test. Data is declared normally distributed if the significance value is greater than 0.05 or $P > 0.05$.

In addition to testing the distribution of values to be analyzed, it is necessary to test homogeneity. The homogeneity test is a test to determine whether the variances of a number of populations are the same or not. The homogeneity test uses Levene's test with the F test. The data variant is declared homegen if the significance value is greater than 0.05 or $P > 0.05$. To test the hypothesis, the data analysis technique used is ANOVA two-away. If there is evidence of interaction, it is then tested with the Tukey test with a significant value of 5 percent (0.05).

Results

The results of this study are in the form of pretest and posttest data which is an overview of each variable involved in the study. This research was conducted at Cangkring Stadium, Karang Sari Field, and Glagah Beach, Kulon Progo, Yogyakarta Special Region. The treatment was carried out with a total of 16 face-to-face meetings on the field and 16 meetings on the beach, with a frequency of 2 (two) meetings in one week. The implementation of this research was carried out by coaches Ari Kurniawan and Bagus Efendi.

Data on pre-test and post-test leg power of PERSIKUP soccer players are presented in Table 2.

Table 2. Pre-test and Post-test Data of Limb Power Results

No	High Sprint Group					
	Training on The Sand (A ₁ B ₁)			Training on The Land (A ₁ B ₂)		
	Pretest	Posttest	Difference	Pretest	posttest	Difference
1	49	57	8	50	55	5
2	48	56	8	49	53	4
3	50	57	7	49	55	6
4	49	56	7	48	53	5
No	Kelompok Sprint rendah					
	Training on The Sand (A ₂ B ₁)			Training on The Land (A ₂ B ₂)		
	Pretest	Posttest	Difference	Pretest	Posttest	Difference
1	48	55	7	48	54	6
2	48	54	6	47	54	7
3	48	55	7	46	53	7
4	46	53	7	47	55	8

Descriptive statistics of pre-test and post-test data on leg power of PERSIKUP soccer players are presented in table 3 as follows.

Table 3. Descriptive Statistics of Pretest and Posttest of Limb Power

Exercise	Accuracy	Statistics	Pretest	Posttest
On The Sand	High (A ₁ B ₁)	Total	196	226
		Average	49	56,5
		Standard Deviation	0.8165	0.57735
	Low (A ₂ B ₁)	Total	190	217
		Average	47.5	54.25
		Standard Deviation	1	0.95743
On The Land	High (A ₁ B ₂)	Total	196	216
		Average	49	54
		Standard Deviation	0.8165	1.1547
	Low (A ₂ B ₂)	Total	188	216
		Average	47	54
		Standard Deviation	0.8165	0.8165

The data normality test in this study used the Kolmogorov Smirnov method. The results of the data normality test carried out on each analysis group were carried out with the SPSS version 20.0 for windows software program with a significance level of 5% or 0.05.

Table 4. Normality Test

Data	P	Significance	Description
Pretest A ₁ B ₁	0.964	0.05	Normal
Posttest A ₁ B ₁	0.417		Normal
Pretest A ₂ B ₁	0.964		Normal
Posttest A ₂ B ₁	0.964		Normal
Pretest A ₁ B ₂	0.846		Normal
Posttest A ₁ B ₂	0.905		Normal
Pretest A ₂ B ₂	0.846		Normal
Posttest A ₂ B ₂	0.964		Normal

Based on the statistical analysis of the normality test that has been carried out using the Kolmogorov Smirnov Z test, on all pretest and posttest data, the accuracy of the long pass is obtained from the results of the data normality test significance value $p > 0.05$, which means that the data is normally distributed.

The homogeneity test is carried out to test the equality of several samples that are homogeneous or not. The homogeneity test is intended to test the similarity of variance between pretest and posttest. The homogeneity test in this study is the Levene Test. The homogeneity test results are presented in Table 5 as follows.

Table 5. Homogeneity Test

Group	Levene Statistic	df1	df2	Sig.	Description
Pretest	.240	1	14	.632	Homogen
Posttest	1.500	1	14	.241	Homogen

Based on statistical analysis of homogeneity tests that have been carried out using the Levene Test. In the pretest, a significance value of $0.632 \geq 0.05$ was obtained. This means that the data group has a homogeneous variant. The calculation results on the posttest obtained a significance value of $0.241 \geq 0.05$. This means that the data group has a homogeneous variant. Thus, the population has a similar variant or homogeneity.

Research hypothesis testing is carried out based on the results of data analysis and interpretation of two-way ANOVA analysis. The sequence of hypothesis testing results is as follows:

1) The first hypothesis reads "There are differences in the increase in leg power trained using Pliometric exercises on the land and Pliometrics in the sand". If the calculation results show a significant effect, the training method has an influence on increasing the leg power of PERSIKUP soccer players. Based on the analysis, the data in Table 6 are as follows.

Table 6. ANOVA Results of Experimental Group Using the Pliometric Exercise Method in sand and Pliometric on the land

Source	Type III Sum of Squares	Df	Mean Square	F	Sig
Training Method	9.000	1	9.000	7.448	.018

Based on the ANOVA test results in Table 6, it can be seen that the significant p value is 0.018. The significance value of p is $0.018 < 0.05$, meaning H_0 is rejected. Thus there is a significant difference in influence between Pliometric exercises on the land and Pliometrics in the sand on increasing the leg power of PERSIKUP soccer players. Based on the results of the analysis, it turns out that the pliometric training method in the sand is higher (good) with an average posttest value of 7.125 compared to the pliometric training method on the land with an average posttest value of 6.00. This means that the research hypothesis which states that there is a

significant difference in influence between Pliometric exercises on the land and Pliometric exercises in the sand on increasing the leg power of PERSIKUP players has been proven.

2) The second hypothesis reads "There is a difference in increasing leg power between players who have high speed and players who have low speed". If the results of the analysis show a significant difference, then there is a difference in increasing leg power between players who have high speed and players who have low speed in PERSIKUP soccer players. The calculation results are presented in Table 7 as follows.

Table 7. Analysis of Differences in the Effect of High Running Speed and Low Running Speed

Source	Type III Sum of Squares	df	Mean Square	F	Sig
Limbs	16.000	1	16.000	13.241	.003

Based on the ANOVA test results in Table 7, it can be seen that the significant value of p is 0.003. The significance value of p is $0.003 < 0.05$, meaning H_0 is rejected. Based on this, it means that there is a significant difference in influence between players who have high speed and low speed in PERSIKUP soccer games. Based on the results of the analysis, it turns out that players who have high speed with an average posttest value of 55.625 are better than players who have low speed with an average posttest value of 53.625. This means that the research hypothesis which states that there is a significant difference in the influence of players who have high speed and low speed on PERSIKUP soccer players has been proven.

3) The third hypothesis which reads "There is an interaction between pliometric training and speed on increasing the leg power of PERSIKUP soccer players". If the results of the analysis show that there is an interaction, it means that pliometric training and speed increase the leg power of PERSIKUP soccer players. The calculation results are presented in Table 8 as follows.

Table 8. Analysis of Interaction between pliometric training and speed

Source	Type III Sum of Squares	Df	Mean Square	F	Sig
Training Method * running speed	2.250	1	2.250	1.862	.197

Based on the ANOVA test results in Table 8, it can be seen that the significant p value is 0.197. The significance value of p is $0.197 > 0.05$, meaning H_0 is accepted. Based on this, it means that the hypothesis stating that there is a significant interaction between pliometric training methods and speed on increasing the leg power of PERSIKUP soccer players is not proven. The diagram of the interaction results between pliometrics and speed on increasing the leg power of PERSIKUP soccer players can be seen in Figure 1 as follows.

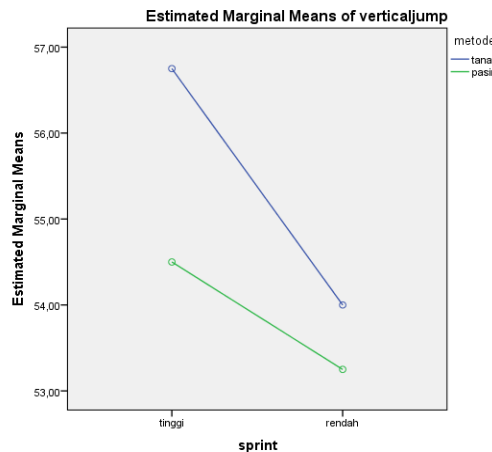


Figure 1. Results of Interaction Between Pliometric Training Methods and Running Speed

Dicussion

Based on hypothesis testing, there are two groups of analytical conclusions, namely: (1) there is a significant difference in influence between the main factors of the study; and (2) there is no significant interaction between the main factors in the form of two-factor interaction. The discussion of the analysis results can be further presented as follows.

1. The Effect of Pliometric Training Methods in Sand and Pliometric on the Land on Increased Limb Power

Based on hypothesis testing, it is known that the method of pliometric training in sand and pliometrics on the land has a significant difference in influence on increasing the leg power of PERSIKUP soccer players. This difference in influence is obtained from the results of the use of pliometric training methods in sand and pliometrics on the land have a significant difference in influence on increasing the leg power of PERSIKUP football players.

Plyometrics is an activity that can increase explosive power. Plyometrics has the principle that the muscles will contract well eccentrically and concentrically. Plyometric training is useful for increasing muscle nerve reactions, explosiveness, speed and the ability to produce strength in a certain direction. Plyometric training is a form of explosive strength training characterized by using very strong and fast muscle contractions, that is, the muscles always contract both when they are elongated (eccentric) and when they are concentric in a short time. Plyometrics has a good effect if done well and with high intensity. Intensive training is strenuous because the workload, repetition and intensity of the movements increase.

The results of the study showed that plyometric training had a significant effect on increasing the player's leg power. This means that the selection of training methods using plyometric exercises in the sand is more effective in increasing leg power, because the results of increasing leg power obtained after training are better than the results of increasing the leg power of players who train using plyometric exercises on the land. In this study, there were two training methods used, namely plyometric training in sand and plyometric training on the land. The results showed the mean value of each group was 7.125 for plyometric training in sand and 6.00 for plyometric training on the land. Therefore, plyometric training on the land obtained a lower mean value than plyometric training on the sand. Plyometric exercises in sand players will get an additional load because, during training, the load obtained by the player during training is not only from his body, but also gets an additional load from the place where practicing. This is because training in the sand will provide additional burden, where the sand is a loose place so that when practicing the player's body weight will be heavier. However, later when players practice on the land, players will get better results.

2. The Effect of Running Speed on Increasing Limb Power

The results of the analysis show that players who have high running speed have a better increase in leg power compared to players who have low speed to increase leg power. Leg power is the ability of the limbs to make the strongest repulsion. Leg muscles are tissues that have a special ability to contract. The limbs are the lower limbs including the legs and pelvis and their joints and muscles (Paul, 2016: 494). Thus, to be able to run fast, leg power is needed, so speed is one of the indicators in determining the increase in leg power.

3. Interaction between Plyometric Training Method and Speed on Increasing Limb Power of PERSIKUP Soccer Players

Based on the results that have been stated in the results of this study that there is no significant interaction between training methods (plyometrics in sand and soil) and speed (high and low) on increasing the leg power of PERSIKUP soccer players. The results showed that the group of players trained using plyometric exercises in the sand will produce a better increase in leg power than trained using plyometrics on the land. This is because, during training the load obtained by the player during training is not only from his body, but also gets an additional load from the place where practicing. Training in sand will provide additional burden, where sand is a loose place so that to practice the player's body weight will be heavier. However, after getting used to heavy training in the sand then when the player practices it on the land, the player will feel lighter and produce better results.

Conclusions

Based on the research and analysis results, the following conclusions can be drawn: 1) There is a significant difference in the effect of plyometric methods in the sand and on the land on increasing leg power in PERSIKUP soccer players. The plyometric training method in the sand is better than plyometric training on the land on increasing leg power. 2) There is a significant difference in the influence of players who have high speed and low speed on increasing leg power in PERSIKUP soccer players. Players who have high speed are better than players who have low speed on increasing leg power in PERSIKUP soccer players. 3) There is no significant interaction between plyometrics and speed on increasing leg power in PERSIKUP soccer players.

Based on the conclusions of the research results, the implications of the research results are as follows: 1) Theoretical implications show that the application of plyometric training methods in sand and plyometrics on the land has a significant difference in influence on increasing the leg power of PERSIKUP soccer players. This gives a clue that in training to increase leg power, the application of the plyometric training method in the sand is more appropriate in increasing the increase in leg power in PERSIKUP soccer players. The plyometric training method in the sand has proven to be able to have a significant effect on increasing the leg power of PERSIKUP soccer players. 2) Practical Implications can be used by soccer coaches to design training programs, especially training programs to increase the leg power of their fostered players.

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