THE EFFECTIVITY OF PLYOMETRIC TRAINING TO INCREASE LEG MUSCLE POWER IN FOOTBALL PLAYERS AGED 17-21 YEARS

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ABSTRACT

The purpose of this study was to find out the effectivity of plyometric training to increase leg muscle power in soccer players aged 17-21 years. The approach of the study was quantitative with experimental methods and the design used was pre-test-post-test control group design. The subjects of the study were football players aged 17-21 years, involving 40 Unsika UKM football players; 20 players for the experimental group and 20 players for the control group. The instruments used in this research were: Vertical Jump Test to collect data on power of leg muscles. The data analysis in this study used t-test statistical method to see the effectiveness of the training model. The results of data analysis showed that: 1) Plyometric training model for increasing leg muscle power can be applied in physical training condition of football players aged 17-21 years; 2) The effectivity of test data showed \( t_{\text{count}} (19.41) > t_{\text{table}} (2.09) \), it can be concluded that the plyometric training model was more effective than the conventional training model in increasing the leg muscle power of football players aged 17-21 years.

Keywords: Leg muscles power, Plyometric training, Football

I. INTRODUCTION

Football has developed into a very popular sport in all levels of society, from children to adult, men and women, and from rural to urban environments. With various backgrounds and different goals, football has become a lifestyle, hobby, and has become a very promising profession. The Indonesian government, in this case, to accelerate football development, issued Presidential Instruction (Inpres) no. 3 of 2019 concerning "acceleration of national football development, for the sake of increasing national and international achievements". In this Inpres, the president instructs 12 ministries, the National Police (Polri), governors and mayors to work together and play role in accordance to their respective duties and functions for the advancement of national football.

Technically, football is a sport that requires good quality technical skills, in terms of the duration of the game. A player must be able to display his/ her technical skills to play within 2 x 45 minutes, during 90 minutes of normal time. Players are required to always move whether with or without the ball, such as dribbling to pass the opponent and kicking into the opponent's goal to create a goal. The emphasis of football lies in team games, which consist of eleven players who cooperate and coordinate with each other. Therefore, a player cannot be separated from his/ her team unit both when attacking and defending.

One of the most frightening things for football players is when injuries happen, whether during matches or training. Sports injuries are injuries that occur during competition, training or after playing sports. Sports injuries occur due to the inability of tissues (muscles, joints, tendons, skin) and other organs of the body to accept the training load during sports. Sports injuries are one of the obstacles experienced by athletes during competition and during competition preparation stage. Because of that athletes must prepare their muscles for training or competition activities.
Sport players in Indonesia prefer traditional methods to treat injuries such as massage rather than using scientifically proven medical methods. In response to this, clubs and players should put injury prevention as priority. In Suryani's dissertation (2019) “a prevention program that can be developed to reduce non-contact incidents focuses on plyometrics, balance and strengthening/stability.” The best prevention of injury is planning and carrying out exercises optimally so that injury can be avoided.

Training aspects for football teams that need to be developed lie in basic technical skills with physical abilities, tactics and strategies that require player have insight and good mentality. Therefore, every trainer is required to understand the stages of training from these aspects so that he/she will know when and how much training portion needed for multilateral and specialization.

By mastering football, players will be able to play the ball in any situation in the game, thus providing convenience in applying tactics and able to create teamwork to achieve victory. Implementing tactics in playing football depends on the maturity or technical mastery of each individual in a team and the power of thought in making decision or initiative. Then without a good mentality, the game will not go as planned.

The strategy and tactics of playing football, including the formation (system) applied by a team, will determine its success in winning the match. The formation is placement, space and division of tasks of each player on the position he/she occupies. This cooperation and formation applies in both attacking and defending situations. There are many formations that can be applied in football, for example 3-4-3, 3-5-2, WM or 4-4-2, 4-3-3, and 2-4-2.

Player’s physical condition in football is a very vital role (Firmansyah, Prasetya, & Ardha, 2021). Without good physical condition, technical and tactical skills cannot be applied optimally. It even affects the mentality of player on the field. Frictions that occur between players are caused by fatigue which causes the players being emotional. This reality implies that physical condition is fundamental in football training. Good physical condition will make it easier to apply techniques and tactics on the field and also provide comfort in playing, since their mentally and emotionally controlled even under the influence of opponent pressure.

A good training program must be planned and structured according to the dose of exercise. In principle, training is a process of change for the better: to improve the physical quality, body function ability, and the psychological quality of athletes. In sports, those processes will be successful if there is collaboration between experienced and knowledgeable coaches and sports scientists who are really engaged in the field of training (Darling-Hammond, Flook, Cook-Harvey, Barron, & Osher, 2020). Football coaches must have competence about football because in the training process, their knowledge is needed so that training can work as expected (Brink, Kuyvenhoven, Toering, Jordet, & Frencken, 2018).

Every training activity always results in changes, including in the anatomy, physiology, biochemistry, and psychology of athletes (Johnson et al., 2011). Therefore, the training component is an important thing that must be considered in determining the dose and training load. Every type of physical activity in 'sports always demand the use of energy. Basically there are two kinds of energy metabolism systems that are needed in every human movement activity, including: (1) anaerobic energy system, and (2) aerobic energy system (Milioni et al., 2018). These energy systems cannot be separated when muscle work activity takes place.

Football competitions in college level have long been held both at the provincial and national levels, such as: the lismajab (Liga Mahasiswa Jawa Barat) for universities in West Java region, the Torabika Cup from the provincial to the national level, and lima (Liga Mahasiswa) which regularly held every year and there is also Menpora Cup, a football tournament for aged 21 which is held every year starting from the provincial level to the national level. The peak of this student competition is at PPLM (Pusat Pendidikan dan Latihan Mahasiswa - Student Education and Training Center) which represents Indonesia in international student tournaments and participates in Ponnas (Pekan Olahraga Mahasiswa Nasional - National Student Sports Week) which is held every two years.

Football coaching among students has been carried out by college in various regions in Indonesia. This guidance is directed to the Student Activity Unit (Unit Kegiatan Mahasiswa - UKM). Many amateur UKM clubs have transformed to professional clubs. In Karawang, Universitas Singaperbangsa karawang (Unsika) has owned and conducted a coaching called football UKM which has been running since February 26, 2011. Football UKM of Unsika is a club for young players to take part in competitions both at local regional and national levels, and also

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at student levels and amateur competitions organized by the Persatuan Sepakbola Seluruh Indonesia (PSSI). Every year football UKM of Unsika regularly participates in competitions held by Kemenpora, lima and lismajab. Throughout their participation in these competitions, football UKM of Unsika has never achieved maximum performance or won any competition. In the last three years, based on interview with football UKM of Unsika coach, Mr. Febi Kurniawan, the Unsika team only won 3rd place in 2016 then passed to enter the competition in 2017 and did not qualify to enter the competition in 2018.

Aside from that, the writers also conducted interviews with the team players participating in the 2017 student league. Based on the observations of football players aged 18 years and over, specifically on college football teams in Indonesia, there were several findings based on observations during matches and direct interviews. From observations of match analysis between football UKM of Unsika against football UKM of Unsil, the indicators of basic football situation, there were 11% kicks that lead to the goal, while not aiming to the goal were 89%, 44% ball position owned by football UKM of Unsika, thwarting goal kicks as much as 8 times out of 10 kicks from 20 attempts, thwarts 30% ball position, and moves the ball from the defending area to the opponent's area 45%.

From the data above, it can be concluded that the level of kicking ability both in kicking the goal and in moving the ball is very low. From the results of physical condition test, leg muscle power affected the ability to play football (Ridwan & Putra, 2021). Judging from that fact, it gave idea that muscle power was a problem that must be solved. Muscle power is one of the most important physical conditions in football game. One approach or strategy to avoid injury and to increase muscle power is through the development of plyometric training model. Plyometric training is one of favorite trainings done by trainers today, especially in sports that require leg or arm muscle power (Slimani, Chamari, Miaraka, Del Vecchio, & Chéour, 2016). Plyometric trainings are very and tailored to the needs of each sport. In this case, the plyometric training was adapted to football that uses a lot of lower extremity muscles (Santos et al., 2021).

Power training is done when the athlete has strength and speed, because power is the product of strength and speed. The form of power motion is always explosive. Therefore, all the forms of exercise on bio motor component of strength and speed can form power training, if done with progressive intensity from light, moderate too fast.

Power training can improve physical function because it involves high-speed movement (Buford, Anton, Clark, Higgins, & Cooke, 2014). That opinion was strengthened by (Kyranoudis, Mylonas, Kyranoudis, & Chatzinikolau, 2020) which stated that power training can be increased if given at the beginning of training so as to create better conditions with strong reflex function. It supported by Radcliffe & Farentinos which stated "power is the application of force through a range of motion within a unit of time" (Radcliffe & Farentinos, 1999). Therefore, power is also related to dynamic balance and affects body posture. Increasing the strength of power can improve functional capacity and dependency, and disability (Granacher, Muehlbauer, & Gruber, 2012).

Plyometric is a method of developing explosive power which is an important component in athlete performance. Plyometric is a combination of strength and speed, and avoids injury by making a good combination program (Radcliffe & Farentinos, 1999). Reinforced by Lubis which stated that plyometric are trainings that aim to link speed and strength movements to produce explosive movements (Lubis, 2004). The term is often used to relate repetitive jumping or stretching reflex practices to produce an explosive reaction.

Plyometric is a quick, powerful movement preceded by a pre-stretch or counter movement, and involving the stretch shortening cycle"(Potach, 2004) . In line with that, Chu and Meyer said "plyometric were meant to be maximal, all out, quality efforts in each repetition of exercise"(Chu & Myer, 2013). Furthermore, plyometric training method bridges the gap between speed and strength. Plyometric method emphazises the movement of stretching muscles quickly, in order to increase the ability of muscle response. The principle of the plyometric method is that the muscles always contraction both when it elongated (eccentric) and shortened (concentric) (Potach, 2004). With the rapid combination of contraction between eccentric and concentric, the energy is stored in the elastic elements of the muscle. This energy is significant in increasing power.

Plyometric is full of explosive movements. Careful preparation must be done to reduce the risk of injury. The choices for location of the training should be on soft surface and avoid hard surfaces. Plyometric trainings are used to train the extrinsic aspects of muscle action(Louder, Bressel, & Bressel, 2015). Many athletes possess
extraordinary strength, but are often unable to generate the power required in explosive activities. Plyometric are often used to improve athletes’ explosive movements.

Football is dominated by muscles and lower extremities (Vaisman et al., 2017). The dominant muscles in football include: upper leg muscles, back and upper back legs, lower legs and ankles, back upper shoulders and arms, abdomen, and front upper arm muscles (Yuwono & Rachman, 2021). Still according to Yuwono dan Rachman, plyometric trainings are grouped into two types, which are: (1) low-intensity practice (low impact), and (2) high intensity practice (high impact) (Yuwono & Rachman, 2021).

Plyometric training at young age must receive special attention (Davies, Riemann, & Manske, 2015). It must be focused on providing plyometric variations to young players. In giving the portion of plyometric trainings, the coach must follow the correct principles and rules. Therefore, the coach must know the predominance of energy system in sport, as well as the characteristics and abilities of the trainees before compiling a program or practices variation so that the plyometric training can be successful and achieve its goals.

Based on the problems, data and facts described above, it is necessary to carry out update training for players’ physical condition, especially the ability of leg muscle power and stability of the football players. The ideas of this study were expected to be able to answer all the problems that have been described. This developed model is something new and different from the existing model. The distinctive feature of plyometric training is that it is carried out with or without a ball; meaning that plyometric training is carried out by implementing basic football techniques with or without the ball. Physical exercise, especially leg muscle power and stability can be trained using the ball. Small field can be used and technical drills can be done to forge players’ power and stability. This is what is called football conditioning (forging the players’ condition through the football itself) (Scheunemann, 2013). “Professional soccer teams use various methods of training to improve the physical conditioning of their players, including both generic (e.g., continuous, intermittent and repeated sprint running) and specific (e.g., small-sided games, soccer- specific and position-specific drills with the ball) exercises” (Hill-Haas, Dawson, Impellizzeri, & Coutts, 2011). In relation to the above theory, in improving the aerobic ability of football players can be done through specific football practices, technique drills and small side games exercises. Small side games can increase aerobic and anaerobic endurance of football players and also develop technical and tactical abilities (Bekris et al., 2012).

II. METHOD

According to Sugiyono, the implementation of this study aims to determine the effectiveness of a model (Sugiyono, 2005). A trial was conducted involving 40 football players from football UKM of Unsika; 20 players for experimental group and 20 players for control group. A quantitative approach in this study used true experimental design in the form of pretest-posttest control group design.

In this design, there are two groups that are chosen randomly, after that these groups were given a pretest to find out whether there is a difference between the experimental group and the control group in the initial state. Pretest results are good if the experimental group scores are not significantly different. The effect of treatment is (O2 – O1) – (O4 – O3).

Figure 1 Research Design in Effectiveness Test Model

In this design, there are two groups, each of which is chosen randomly (R). The first group is given treatment (X) and the other group is not. The group that is given treatment called the experimental group and the group that is not treated called the control group, then a prettest was given to determine the initial state. The effect of the treatment is (O1: O2). According to Sugiyono, the effect of treatment is analyzed by t-test statistics. If there is a significant difference between the experimental group and the control group, then the treatment given has a significant effect.
The treatment given in this study was plyometric and conventional training models. The treatment was carried out in 14 training sessions. The steps taken to test the effectivity of the model were: (1) assigning players as study subjects as many as 20 football players as the experimental group and 20 football players in the control group; (2) carry out the pre-test, which was vertical jump test to both of the groups; (3) implementing plyometric training model to increase the power and stability of the players aged 17-21 years to the experimental group for 16 meetings, while the control group was not given treatment; (4) conducting vertical jump test post-test to both of experimental and control groups; (5) analyzing the results of the pre-test and post-test using statistical methods (t-test) to find out whether there was significant difference in the effectivity of training between both groups.

III. RESULTS AND DISCUSSION

After all the requirements were met for further analysis, then the effectiveness test was carried out. Before testing the effectivity of the trainings, the writers first looked at the effect of the training model that had been prepared to increase leg muscle power ability of football players. Experiments were carried out on football UKM of Unsika players by involving 20 players aged 17-21 years. The treatment was given for 16 meetings with frequency of 3 times a week. However, before given the treatment, the initial data was taken (by pre-test), this was intended to be used as comparison for the final data (post-test). In testing the effectiveness of the model, the researcher made 3 comparisons to this model. The following are described one by one:

Table 1. Pretest and Posttest in Experiment Group

<table>
<thead>
<tr>
<th>Paired Samples Statistics</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1 Tes_Awal_Kelompok_Eksperimen</td>
<td>32.95</td>
<td>20</td>
<td>1.356</td>
<td>.303</td>
</tr>
<tr>
<td>Tes_Akhir_Kelompok_Eksperimen</td>
<td>44.90</td>
<td>20</td>
<td>1.586</td>
<td>.355</td>
</tr>
</tbody>
</table>

Paired Samples Correlations

<table>
<thead>
<tr>
<th>N</th>
<th>Correlation</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>.536</td>
<td>.015</td>
</tr>
</tbody>
</table>

The output above showed the results of correlation between the two data or the correlation between the pretest and the posttest test variable of the experimental group. Based on the results of data analysis, it was known that the correlation coefficient was 0.536 with a significance value (Sig.) of 0.015. Because the Sig. value was 0.015 < the Probability 0.05, it can be said that there was correlation between the pretest and the posttest on the experimental group.

Table 2. The decision making in the “Paired Sample Test”

<table>
<thead>
<tr>
<th>Paired Samples Test</th>
<th>Paired Differences</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>Interval of the Lower</th>
<th>Upper</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1</td>
<td>Tes_Awal_Kelompok_Eksperimen - Tes_Akhir_Kelompok_Eksperimen</td>
<td>-11.950</td>
<td>1.432</td>
<td>.320</td>
<td>-12.620</td>
<td>-11.280</td>
<td>-37.326</td>
<td>19</td>
<td>.000</td>
</tr>
</tbody>
</table>

If the Sig. value (2-tailed) < 0.05, then H0 is rejected and Ha is accepted. On the other hand, if the Sig. value (2-tailed) > 0.05, then H0 is accepted and Ha is rejected.

Based on the table Paired Sample Test, the experimental group had Sig. value (2-tailed) of 0.000 < 0.05, then H0 was rejected and Ha was accepted. It can be concluded that there was average difference between the results of
the pretest and posttest of the experimental group, which means that there was a significant effect of the plyometrics training model in increasing leg muscle power of football UKM players aged 18-21.

Table 3. Pretest and Posttest of Control Group

<table>
<thead>
<tr>
<th>Paired Samples Statistics</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1 Tes_Awal_Kelompok_Kontrol</td>
<td>32.90</td>
<td>20</td>
<td>1.553</td>
<td>.347</td>
</tr>
<tr>
<td>Tes_Akhir_Kelompok_Kontrol</td>
<td>34.10</td>
<td>20</td>
<td>1.917</td>
<td>.429</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Paired Samples Correlations</th>
<th>N</th>
<th>Correlation</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1 Tes_Awal_Kelompok_Kontrol &amp; Tes_Akhir_Kelompok_Kontrol</td>
<td>20</td>
<td>.888</td>
<td>.000</td>
</tr>
</tbody>
</table>

The output above showed the results of the correlation between the two data or the correlation between the pretest and the posttest in the control group. Based on the results of data analysis, it was known that the correlation coefficient was 0.888 with a significance value (Sig.) of 0.000. Because of the Sig. value was 0.000 < Probability 0.05, it can be said that there was correlation between the pretest and the posttest in the control group.

Table 4. The decision making in the “Paired Sample Test”

<table>
<thead>
<tr>
<th>Paired Samples Test</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1 Tes_Awal_Kelompok_Kontrol - Tes_Akhir_Kelompok_Kontrol</td>
<td>-1.200</td>
<td>.894</td>
<td>.200</td>
</tr>
</tbody>
</table>

If the Sig. value (2-tailed) < 0.05, then H0 is rejected and Ha is accepted. On the other hand, if the Sig. value (2-tailed) > 0.05, then H0 is accepted and Ha is rejected.

Based on the table Paired Sample Test, the control group had Sig. value (2-tailed) of 0.000 < 0.05, then H0 was rejected and Ha was accepted. It can be concluded that there was average difference between the results of the pretest and posttest of the control group.

Table 5. Comparison Test of Experimental Group and Control Group

<table>
<thead>
<tr>
<th>Group Statistics</th>
<th>Kode_Eksperimen_dan_Kontrol</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tes_Akhir_Kelompok_Kontrol</td>
<td>20</td>
<td>44.90</td>
<td>1.586</td>
<td>.355</td>
<td></td>
</tr>
<tr>
<td>Tes_Akhir_Kelompok_Kontrol</td>
<td>20</td>
<td>34.10</td>
<td>1.917</td>
<td>.429</td>
<td></td>
</tr>
</tbody>
</table>

**Independent Samples Test**

<table>
<thead>
<tr>
<th>for Equality of variances assumed</th>
<th>Equal</th>
<th>Sig.</th>
<th>t</th>
<th>df</th>
<th>Mean Difference</th>
<th>Std. Error Difference</th>
<th>Confidence Lower</th>
<th>Confidence Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tes_Akhir_Kelompok_Kontrol</td>
<td>.844</td>
<td>.364</td>
<td>19.414</td>
<td>38</td>
<td>.000</td>
<td>10.800</td>
<td>.556</td>
<td>9.674</td>
</tr>
</tbody>
</table>

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The basic in determining the Independent T Test is based on the significance value (2-tailed) which measures whether there is an average difference in the subjects being tested. The significance value (2-tailed) > 0.05 indicates that there is no difference in average between the study subjects. The significance value (2-tailed) < 0.05 indicates an average difference between the study subjects.

Based on the "Independent Sample Test" table, the control group had Sig. value (2-tailed) of 0.000 < 0.05, then H0 was rejected and Ha was accepted. Therefore, it can be concluded that there was an average difference between the experimental group test results and the control group. Since the experimental group given the plyometric training model treatment, the test results were better than the control group in increasing leg muscle power of football UKM players aged 17-21.

Based on the results of the effectivity test and the discussion of the results, in can be concluded that: the plyometrics training model was effective in increasing leg muscle power of football players aged 18-21 year old.

REFERENCES