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Original Article Research

Modeling Exercise Plyometric on Vertical Jump Ability in Football Player Heading

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Abstract

This study is based on observations made during training at SSB Kabomania Muda Nusantara. It was found that the students had poor heading skills, that the coaches did little plyometric training to increase the explosive power of the leg muscles because the students had poor jumping power, that the training program was not measurable, and that the students were, on average, of short stature. The aim of this study was to investigate the influence of plyometric model exercises, namely different variations of the depth jump and the single-leg jump, on jumping power. The sample consisted of 15 individuals, who were selected using targeted sampling. The research method was a quantitative experiment with a pre-experimental design of one group with pre-test and post-test, i.e., a research design in which one group underwent a pre-test and a post-test. The research results showed that before training with depth jumps and single legs (pre-test), most statistical results were at 42.2, which means that the vertical jumping power of most soccer players was adequate to very poor. After training with depth jumps and single legs (post-test), the statistical value was 57.2, which means that vertical jump power improved to very good. This was confirmed by the t-test, where t > t-table, i.e., 6.91 > 2.14, so the alternative hypothesis (ha) was accepted and the null hypothesis (h0) was rejected. To complete the homogeneous results, further research is needed on the application of the sample group of students with the same average height.

Keywords: modeling exercise plyometric, vertical jump, depth jump, single leg, heading.

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1. INTRODUCTION

The determination of the victory achieved by a team in the game of football has many factors that must be achieved to be considered, techniques, physicality and strategies must be optimized by coaches and players. Coaches have a great contribution in achieving indicators that must be achieved, practice is the decisive subject in a victory (Saputra et al., 2021) training is developing elements of the game of football which are very crucial shown to grow playing skills. Practice can be interpreted as the process of adjusting the body to heavier work guidance to prepare for match situations. (Pembayun et al., 2018) Training is the process of coaching sports with a scientific approach, especially pedagogical principles, in an organized and planned manner to foster athletes' achievement and balance. This means that actually every effort to improve training must develop components and needs to be carried out as a priority. Studies (Hermawan et al., 2021), physical condition is the most important element in maintaining physical resilience. Therefore, systematic and programmed physical exercise is necessary to achieve good physical condition. In a study (Ridwan & Irawan, 2018) good physical condition is the basis for developing techniques, tactics, and strategies in football. Physical fitness training according to opinion (Ridwan, 2020) focuses more on the physical development of athletes in general and is a crucial element to achieve the best achievements. The purpose of physical training also includes measuring and reducing injuries and ensuring that each athlete actually has a physical condition that supports the achievement of achievement.

The results of the study conducted by (Sitompul & Sholihamia, 2020), children (students) need enough physical activity to stimulate their growth and development. The laws and principles of motion must be observed during physical activity. Opinion (Sitompul & Sholihamia, 2020) states that children actually need enough physical activity to stimulate their growth and development, physical exercise puts the body under regular and continuous pressure, which is able to grow athlete performance. Physical condition is another thing that needs to be considered by coaches in creating a good team. Based on the results of the direct review that has been carried out to see the initial ability of the students of SSB Kabomania Muda Nusantara, during the training session, problems were seen, namely the failure of students to head the ball given in the training session, the low jump range results, the training program lacked the provision of plyometric exercises by the trainer to grow the explosive power of the leg muscles due to the lack of stable physical condition. Based on the initial problems, the solution that will be provided so that the problem is solved, namely by providing measurable and structured exercises with modeling from the analysis of the needs that occur in the problems faced, which is the solution in solving the problems faced by students, the plyometric practice approach that will be offered with modeling that is prepared by the program adjusting to the needs of students.

In the study (Pembayun et al., 2018) plyometric exercises helped develop the neuromuscular system as a whole, supported a wider range of motion, and were especially beneficial for sports that require speed and muscle strength. (Sudarmanto et al., 2019) plyometrics involves strong muscle contractions in response to rapid and dynamic muscle loads or stretches. (Wea & Samri, 2022) highlights the advantages of plyometrics in applying power and speed, stimulating various sports such as jumping, running, and throwing. (Ujang Rohman & Ramadhani, 2020) explained that plyometric training actually involves a combination of eccentric and concentric exercises with dynamic loads, helping to grow muscle explosiveness. Specific movements in football that require rapid eccentric and concentric muscle contractions can be

improved through plyometric exercises.

(Sobarna et al., 2019) plyometric exercises are quantitatively able to grow vertical jumping power, leg muscle explosiveness, and the ability to change direction quickly. (Hidayat et al., 2017) added that this exercise is actually very suitable for sports that require explosive power, such as football which involves elements of speed and muscle strength. Overall, plyometric exercises are an effective method for growing muscle explosiveness, combining isometric and isotonic exercises with dynamic loads. Sudden muscle stretching before muscle contraction again allows the muscle to reach maximum strength in a short period of time. (L Alex Aldha Yudi et al., 2019) The principle of the plyometric training method is that the muscles always contract, both when lengthening and when shortening. Plyometric exercises foster muscle nerve response, explosiveness, speed, and the ability to exert force in a specific direction. The plyometric training method is a method of developing explosive power, which is a crucial part of most sports performance.

(Sudarmanto et al., 2019) said that plyometric depth jump is a form of exercise that has the same goal, namely to train leg strength, but in carrying out this form of exercise must require a high jump effect to get jump results. Depth jump is done by stepping out of the box and falling to the ground, then trying to jump back to the height of the box. Deep jump training is a type of dynamic exercise where a person jumps out of the box 30cm tall and jumps up. When the athlete is on the floor, he must perform vertical jumps with maximum power in the shortest possible time on the floor. (Wea & Samri, 2022) Depth jump training is a form of plyometric exercise, where this exercise aims to grow leg muscle strength in the hope of being able to grow the ability to jump or jump correctly and accurately. The purpose of depth jump training is to grow the athlete's ability to react, the less the knee bounces and the fewer feet touch the floor, the more effective the jump results will be.

(Afifah, I., & Sopiany, 2017) said that to provide exercises that contribute positively to the results of plyometric depth jump training, it can be composed with 10 repetitions as many as 3 sets with a frequency of practice 4 times a week and a duration of training of 6 weeks. (Pomatahu, 2018) explains the advantages and disadvantages of plyometric depth jump exercises; (1). Advantages of plyometric depth jump *exercises a).* This exercise is easy to carry out. *b).* Psychologically, this exercise is easier because the height does not change. *c).* It is safer because the ground level is fixed. (2). Lack of plyometric depth jump exercises. *a).* The eccentric (elongated) and concentric (shortening) elements to muscle contraction do not increase much as movement increases. *b).* Athletes get bored easily because of fixed movements and positions, as a result of which motivation is not stimulated.

(Ujang Rohman & Ramadhani Hananto Puriana, 2020) Single leg exercise is a form of one-leg jump that repeatedly strengthens the leg muscles with a focus on strength and speed, which has an impact on increasing explosive power. (Pembayun et al., 2018) explained that the single leg jump exercise is rarely carried out in a variation of leg strength training without using a box jump. This exercise is considered a solution to grow leg muscle strength in football players, especially in overcoming the lack of explosive power. The single leg method aims to strengthen the lower back muscles and grow explosiveness effectively. (Pomatahu, 2018) in the results of his study explained the advantages and disadvantages of plyometric single leg jump exercises. (1) Advantages of Single Leg Jump Training; *a)* The muscles of the legs contract quickly. *b)* The movements are easy to execute. *c)* Run anywhere either indoors or outdoors. *d)* In the single leg

jump exercise, it is able to effect the explosive power of the leg muscles. (2) Weaknesses of Single Leg Jump Training; *a)* Stamina is depleted faster. *b)* Gets tired faster because when jumping you have to be high to get the explosive power of the leg muscles. *c)* Movement is getting slower and slower.

Based on the previous explanation, the modeling of plyometric Depth Jump and Single Leg Jump exercises will be formulated to make the treatment of problem solving, the preparation of training doses also makes things that must be considered in the annual training given prioritize the principles of training and FITRS (Frequency, Intensity Time, Rest, Set) which is the arrangement of doses and the purpose of each exercise given to provide special achievements in the training output. In the modeling of Depth Jump exercises, there are 21 variants of exercises in which there are the use of internal and external weights and additional gear in their implementation, 14 variants of exercises without using external weights while 7 variants of movement use external weights or training devices, while in Single Leg Jump exercises there are 14 variants of exercises using body weights and 7 variants of movements using additional weights and training support devices. The time of the exercise will be given 14 meetings in the implementation of treatment while 2 meetings are held to find out the results of the students' jumps.

2. METHOD

This study uses experimental quantitative methods as an approach to find the effect of certain treatments on other variables under controlled conditions. (Sugiyono, 2014) explained that this experimental researcher actually uses a pre-experimental design, which is a research design that involves a group or class with the provision of pre-tests and post-tests.

2.1 Participants

Sample collection is carried out by NonProbability Sampling (Purposive sampling) where samples are selected among the population according to the researcher's desires, as a result of which the sample is able to represent the desired population characteristics. Sample collection was carried out by purposive sampling where all SSB Kabomania Muda Nusantara players were used as a sample in this study which consisted of 15 people aged 15 – 16 years. (Maharani & Bernard, 2018) said that it is a technique or way of determining and collecting samples determined by the author with certain considerations. The criteria in determining the sample of this study include; *(1)* SSB Kabomania Muda Nusantara Bogor *Development (2)* Ages 12-16 Years *(3)* SSB Kabomania Muda Nusantara Bogor Students who are still active in training (*4)* Not in a sick state.

2.2 Research Design

According to (Sugiyono, 2014), pre-experimental design is a design that involves only one group that is given tests before and after treatment. This design was performed in a single group without any control group or comparison group. In this study, the researcher used the One-Group Pretest-Posttest Design, which describes the actual group being given pre-test before treatment and post-test after treatment. In the implementation of the research, the two variables were tested for their influence through the initial implementation mechanism, then the provision of treatment during a predetermined time and after that the final results of the students' abilities were tested through a predetermined test instrument.

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2.3 Instruments

The instrument used in this study is the Vertical Jump (Modified Sargent Jump) test and measurement, which aims to measure the explosive movement of the body, especially the lower limbs. The measuring instruments used are a jump meter board with centimeters, and a stationery to record test results. Vertical Jump is used as a parameter that gives an idea of a person's body mass. In its implementation, the values obtained will be categorized according to the results of the jump, the categories can be seen in table 1.

Tabel 1.

Vertical Jump Rating Range

Shoes	U12 - 16	Criterion
5	>63	Very good
4	59-62	Good
3	35-58	Enough
2	20-34	Less
1	<19	Less Than Once

Source: (KEMDIKBUD, 2023)

2.4 Procedures

The series of processes for implementing this research begins with examining the weaknesses and shortcomings based on the results of the analysis of the needs of the problem, the process of collecting secondary data is carried out with a direct review, then the hierarchy is carried out the preparation of a series of training doses and the application of exercise modeling that will be given to intervene in the results of the high variable jump (y) that will be produced by students. The implementation process is carried out by conducting a trial (pretest) on students by applying the test instrument protocol, namely vertical jump, after the results obtained are followed up from the implementation of treatment by applying the entire training model for 6 weeks by providing all annual training that has been prepared from the beginning. Furthermore, in the process of implementing the final review to see the ability of the student's jump height, a similar test was carried out, namely vertical jump, the results carried out by all students will be converted into numerical to be analyzed using the SPSS application version 23, the results obtained from the test will answer the hypothesis of the problem and can answer the intervention of the variable (x), namely the application of exercise modeling on the results of the jump (variable y).

2.5 Data Analysis

In this study, it is necessary to carry out data analysis techniques to answer the formulation of the problem and test the hypothesis. (Sugiyono, 2019) stated that the data analysis technique is actually related to estimation to answer research questions and test the hypotheses submitted. Therefore, it is necessary to carry out prerequisite tests, testing of measurement data related to the purpose of the research to help the analysis by using three tests, namely the Normality Test whose purpose is to find out whether the data is normally distributed or not. One of the methods that can be used is the Kolmogorov-Smirnov Test with a significance level of 0.05. Furthermore, the Homogeneity Test is carried out to ensure that the groups that make up the sample come from a

homogeneous population, the homogeneity test is able to use the Levene's Test from the pre-test and post-test in the experimental group, and finally the Hypothesis Test, the results of data reduction in the experimental research will be examined using a statistical framework, but it also pays attention to the type of experimental research used. In the case of this study, the author uses the results of the assessment before and after the implementation of an action.

3. RESULTS

In conducting the normality test, it is used to find out whether the data from each variable is normally distributed or not. The formula used by the researcher is the Kolmogorov smirnov formula by applying the help of the SPSS application. By applying the formula to find out whether the frequency distribution of each variable is normal or incapable from the value of Asymp. Sig. The basis for decision-making in the normality test of (Saifuddin's, 2015) opinion is: if the sig (significance) < 0.05, then the data is distributed abnormally and if the sig (significance) is > 0.05, then the data is distributed normally.

Tabel 2.

Uji Normalitas

		Unstandardized Residual
N		15
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	5.61121820
Most Extreme Differences	Absolute	.137
	Positive	.080
	Negative	-.137
Test Statistic		.137
Asymp. Sig. (2-tailed)		.200[c,d]
a. Test distribution is Normal.		
b. Calculated from data.		
c. Lilliefors Significance Correction.		
d. This is a lower bound of the true significance.		

Based on the results of Kolmogorov Smirnov's Out Put One Sample, the data obtained is 0.200 > 0.05, therefore the above data is normally distributed.

Next, the homogeneity test is to show that two or more sample data groups come from populations that have the same variance. Homogeneous is fulfilled if the sig value is >0.05, then the variance of each sample is the same (homogeneous). On the other hand, if the significant obtained is <0.05, then the variance of each sample is not the same (not homogeneous). With the help of SPSS statistical data processing computer software version 25, the homogeneous test results are shown in table 3.

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Tabel 3

Uji Homogenitas

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Vertical Jump	Based on Mean	3.655	1	28	.066
	Based on Median	4.276	1	28	.048
	Based on Median and with adjusted df	4.276	1	27.656	.048
	Based on trimmed mean	4.070	1	28	.053

Based on the out put of homogeneity of Variances, a sig value (significance) of 0.066 is obtained greater than 0.05 (0.066 > 0.05), then the alternative hypothesis is accepted so that the variation of each sample is equal (homogeneous).

To see whether or not the effectiveness of using depth jump and single leg exercises to improve children's vertical jump skills can be carried out with a statistical analysis of different tests (t-test). In order to answer the formulation of the problem, the hypothesis test carried out applies the "T" test. Before the "T" test is carried out, it is first made in Table 4 of the assessment of the "t" value

Table 4.

Hypothesis Value Results

DATA SELISIH PRETEST POSTTEST																	
N O	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		AVERAGE
NAME	World cup	AS	THEM	ONE	HAS	On the	SS	AG	WHERE	MG	I	AGO	KA	AND	RAA	SUM	
AGE	15	16	16	16	16	16	15	16	16	15	15	15	16	16	15		
PRETEST	36	19	44	43	54	54	33	60	46	34	34	61	60	34	24	636	42,4
POST - TEST	60	30	59	62	61	63	60	65	62	48	59	64	63	53	49	858	57,2
DIFFERENCE (D)	24	11	15	19	7	9	27	5	16	14	25	3	3	19	25	222	14,8
D 2	576	121	225	361	49	8 1	729	25	256	196	625	9	9	361	625	4248	283,2

The next step is to provide the interpretation of the results of the study on t0, by first taking into account the df and db, df = N-1 = 15-1=14, comparing the magnitude of "t" obtained with the calculation of t0 = 6.91 and the magnitude of "t" which is listed at a significant level of

5%, namely tt 5% = 2.14, then it can be known that t0 is greater than tt which is 6.91 > 2.14, then the alternative hypothesis (ha) is accepted and the null hypothesis (h0) is rejected. So it can be concluded that the application of plyometric depth jump and single leg exercises is effective in improving vertical jump abilities in soccer players.

4. DISCUSSIONS

Based on the results of the analysis that has been carried out regarding plyometric depth jump and single leg exercises to grow vertical jump skills in football player heading, it can be concluded that actually with the use of plyometric depth jump and single leg exercises to grow vertical jump skills in heading, inferentially there is a significant increase in vertical jump ability in heading. This can be seen by comparing the magnitude of "t" obtained by the author (t0 = 6.91) and the magnitude of "t" listed in tt, which is 2.14 (6.91> 2.14). This means that actually plyometric depth jump and single leg exercises are effectively used to grow vertical jump ability in heading with a significance level of 5%, so it can be analyzed actually t0 large from tt (t0 > tt) as a result H0 is rejected and Ha is accepted, this means that actually plyometric depth jump and single leg exercises are effectively used to remind vertical jump abilities in the heading of football players.

Plyometric exercises are effective in growing vertical jumps because of their explosive movements, including elements of muscle strength, muscle endurance, flexibility, and agility. Maximum muscle contraction in plyometric exercises helps develop muscle strength and joint stabilization to support vertical jumps. The importance of running vertical jumps gradually because the increase in mass does not grow, but can actually decrease the ability to jump vertically. (Adhitya Bagaskara, 2019) emphasized that in developing vertical jump, it is necessary to pay attention to exercises to grow explosive power. The success of vertical jumping not only depends on good technique, but also on optimal physical conditions, including explosive power.

To optimize vertical jump exercises, three systems are able to play a role, namely the cardiovascular system, musculoskeletal system and neuromuscular system. Conventional exercises and strength training on the musculoskeletal system, such as jumping up and forward with knees bent, are capable of developing muscle explosiveness. The importance of doing maximum contractions when lifting weights to grow muscle strength and joint stabilization, thus supporting the gradual increase of vertical jump. Thus, plyometric training and attention to explosive power development through conventional training are able to effectively cultivate vertical jumps in a gradual and measurable manner. In Sozbir's (2016:1-18) study, the characteristics of jumping movements (short-stretched cycles, closed kinetic chains, and relatively high speeds are similar for most jumps in athletic activities). In addition, the arm control eliminates the influence on the test effect, which better reflects the function of the lower extremities. It is very relevant to athletic performance and rehabilitation after injury. Therefore, vertical jumps are often used as a function of the index motion member or its explosive power. There are different types of jump tests that require different muscle functions namely vertical squat jumps, vertical reverse jumps, and cyclic jumps.

Several methods have been proposed to assess the asymmetry of the force of the lower extremities. The most common isokinetic assessment. It measures the bilateral strength of specific muscle groups such as the extensor and flexor of the knee. However, this requires very expensive equipment, and assesses open kinetic chain movements and dyskinetic muscles, whereas the most

athletic activities are characterized by closed kinetic chain movements and rapid muscle action with stretch-shortening cycles. For this reason, functional tests such as the one-legged jump test have been developed. With the vertical jump test it is possible to directly measure the force exerted by each leg during the vertical CMJ. entheisokinetic and CMJ measurements, the more functional properties of CMJ are able to provide more comprehensive insights into neuromuscular function through detailed analysis of CMJ's force-time curves.

Football is only about classy goals from long ranges, but also deadly headers from the highest jumps. Kicking and running are indeed the determining factors a player can compete in the top flight of European football competitions, rarely do players rely on jumps. But it is not uncommon for tall players to use these advantages to become a deadly weapon, such as a striker. Strikers with high posture can take advantage of their advantages to win aerial duels and score goals through headers. However, not all players have high posture to be able to take advantage of their advantages, only players with high jump specializations. By having a high jumping ability can provide wide benefits in creating chances of winning, this exercise is very useful for improving jumps that can be executed through headings. Here is a list of football players with high jumping skills. *Cristiano Ronaldo Cristiano Ronaldo* 's jump became the highest in history, at that time in the round of 16 of the 2012-2013 Champions League, Ronaldo made a jump of 2.93 meters high. Youssef En-Nesyri At that time, En-Nesyri broke into the Portugal goal with a spectacular header with a jump of 2.78 meters. *Bevis Mugabi* plays for Motherwell, having a high jump of 2.62 metres against Ross Contry. *Fikayo Tomori's high jump reached a height of 2.61 meters created in the Italian League in AC Milan's match against Juventus in 2021.*

5. CONCLUSIONS

Based on the results of research and analysis that has been carried out regarding plyometric depth jump and single leg exercises to grow vertical jump skills in football players' headings, it can be concluded that with the use of plyometric depth jump and single leg exercises to grow vertical jump skills in heading, inferentially there is a significant increase in vertical jump ability in heading. This can be seen by comparing the magnitude of "t" obtained by the author (t0 = 6.91) and the magnitude of "t" listed in tt, which is 2.14 (6.91> 2.14). This means that actually plyometric depth jump and single leg exercises are effectively used to grow vertical jump ability in heading with a significance level of 5%, so it can be analyzed actually t0 large from tt (t0 > tt) as a result H0 is rejected and Ha is accepted, this means that actually plyometric depth jump and single leg exercises are effectively used to remind vertical jump abilities in the heading of football players.

There are advantages and disadvantages in the results of this study that can be used as a contribution to further research, *the advantage* lies in the many variants of the exercises applied so as to provide the effect of physical ability development in students as well as the right dosage formula that has a productive effect on students' abilities, *shortcomings* The results of this study have not been positively validated in the female sample, it is expected for the researcher to then provide this research intervention to the female sample to see if the program of this study has an effect on the sample.

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