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The Effect of Plyometric and Balance Training Methods on 100 Metres Running Ability in Junior High School Students State 2 Bitung

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Abstract. *The purpose of this study was to determine: (1) The difference in the effect of plyometric training methods between double leg bound training and double leg vertical power jump training on 100-meter running ability, (2) The difference in the effect between high balance and low balance on 100-meter running ability, (3) Interaction between plyometric and balance training methods on 100-meter running ability. The instruments used to collect data were: (1) Balance test (Modified Bass Test of Dynamic Balance), (2) 100-meter running ability test with time test, (3) Training program as a guideline that will be used in providing treatment . The data analysis technique used was Analysis of Variance (ANOVA) at a significance level of α = 0.05. The results of the hypothesis testing proved that: (1) There is no difference in the influence between double leg bound training and double leg vertical power jump training on 100-meter running ability. By looking at the similarity of the movements that both jump use both legs, it seems that these two exercises are variations in training, as a result the two plyometric training methods are not significantly different. (2) There is a difference in the influence between high balance and low balance on 100-meter running ability. The results of the data analysis showed that high balance has a significant difference in influence with low balance. (3) There is no interaction of influence between plyometric and balance training methods on 100-meter running ability. Related to the interaction hypothesis, it turns out that the results of the hypothesis testing have proven that there is no interaction between plyometric and balance training methods on 100-meter running ability where the calculated F value = 0.006 < than the F table value = 2.82 at a significance level of α = 0.05. Conclusion of the study: 1) There is no significant difference in influence between double leg bound training and double leg vertical power jump training on 100-meter running ability. 2) There is a significant difference in the influence of high balance and low balance on 100-meter running ability. 3) There is no interaction between plyometric training methods and balance on 100-meter running ability.*

Keywords*: Plyometric, Balance, Training, Running*

1. INTRODUCTION

In today's increasingly advanced era, sports activities cannot be separated from humans. For everyone, sports are very important to maintain physical health and fitness, therefore efforts to popularize sports must begin at an early age, in which what must be done is through a regular training program that we apply, it is expected to achieve goals that include the formation and development of physical and spiritual growth and development.

Looking at sports achievements in Indonesia, it shows that the increase in achievement in Indonesia is lagging behind neighboring countries such as Thailand, Singapore and Vietnam. All of this can be seen from Indonesia's participation in various championships such as the Sea Games, Asia Games and even the Olympics which show that Indonesia's achievements are declining. Several factors that can cause the decline in

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achievement in Indonesia include the role of the local government, facilities and infrastructure that have not been met, the use of training methods that are not optimal, coaching that is not yet optimal and the lack of understanding of coaches in preparing training plans and programs. The cause of the achievement gap is the lack of young athletes who can replace senior athletes who are old and whose level of achievement has not received any achievements.

Specifically in the athletics branch of sport in the short-distance running event, there seems to be a gap in achievement where Indonesia once had a short-distance runner who had participated in the Olympics, namely Purnomo, where he was able to compete with athletes from all over the world until reaching the semi-finals with a time of 10.47 seconds held in Los Angeles in 1982. In 1989 Mardy Lestari broke the national record with a time of 10.20. After a few years, a new name emerged, namely Muh Zohri, who became the fastest runner in the 2018 junior world athletics championship which took place in Tampere, Finland and was able to record a time of 10.18 seconds in the 100-meter race and made Zohri the record holder for the fastest runner in Indonesia to date.

Many factors can affect the success of sprinting achievements, with training methods being one of the factors that occupy the most important position in terms of improving achievements, even though someone has high talent and potential but is not supported by maximum training, it is difficult to achieve optimal achievements. Experts such as Bompa, Farentinos, and Radcliffe suggest that one way to improve sprinting achievements is to use the plyometric training method.So plyometric training is one of the exercises that is suitable for sports that require explosive, namely movements that contain elements of speed and strength, for example athletics, short-distance running, which requires leg muscle power. One of the references for coaches in developed countries is to use this training method. The method increases speed, power, reaction and muscle elasticity.

In Indonesia, the plyometric training method has long been known among trainers, but in reality until now the application of this training method has not been optimized in improving performance. Seeing the reality that occurs in the field, the researcher tried to provide training to increase existing potential, namely by providing plyometric training, and seeing how much it affects the ability to run 100 meters. There are so many plyometric training methods that are developing and can be used, but this study only focuses on plyometric trainingDouble Leg Bound and double leg vertical power jump. This exercise is useful for developing speed and explosive power that is treated when running. Both of these movements have similarities with the movement when running, namely using both

feet as a support to push the body forward alternately. The use of this form of exercise is based on the opinion of experts who say that in increasing speed it is necessary to add strength and increase speed to the movement of the leg muscles (lower limbs).

Against this background, coaches must also collaborate with existing sports teachers in developing and improving achievements, especially in the athletics branch in short-distance running.Based on the facts and reality in the field, the researcher tried to develop and provide plyometric training, and how much influence it has on the ability to run 100 meters. Especially applied to students at SMP Negeri 2 Bitung in developing short-distance running achievements. There are so many plyometric training methods that are developing and can be used, but in this study it only focuses on double leg bound and double leg vertical power jump plyometric training. In addition to the use of training methods that support the development of improved achievement in students at SMP Negeri 2 Bitung, physical condition ability is also very important in improving achievement. Balance is an important physical component in improving athlete achievement. Balance has an important role for every student, especially in short-distance running. Therefore, every teacher and even coach must know the level of ability of each student and athlete in order to improve the speed, balance, and ability of each student and athlete.

Athletics is a physical activity consisting of basic dynamic and harmonious movements, namely walking, running, jumping and throwing. Basically, basic techniques/movements must be truly understood and studied first, in order to determine achievements in the athletics sport. Short distance running or sprinting is a way of running where athletes must cover all distances at maximum speed. This means having to run as fast as possible, using all your strength from the start (starting from the start) to crossing the finish line (finished).

A runner must know the basic knowledge of sprinting or short-distance running before he steps into sprinting techniques. Bompa (1999) explains, some basic things that must be understood by sprinters, are as follows:

a. Lean your body slightly forward when running, the angle of both arms is slightly flexed at 90 degrees, then when running the hands are swung in one direction.
b. Relaxed condition of the muscles of the front and both arms.
c. The lower leg is pushed off strongly until it is straight, and the front is lifted until it is parallel to the ground.
d. Keep your waist height the same throughout the run.

e. The body is simultaneously leaned forward when reaching the finish, so that the chest can reach the ribbon.

After we understand Bompa's (1999) description of the basic techniques of short-distance running above, it is a good idea for us to also learn the following techniques to maximize results in short-distance running. Here are some short-distance running techniques:

a. Short Distance Running Start Technique
b. Short Distance Running Techniques
c. Finish Line Crossing Technique

Principles of Practice

The use of a training method can achieve its goals and objectives if it is implemented properly. fulfill the basic principles of training. Among the principles of training according to Bompa in Nala (2001: 14-15) are:1) active and serious, 2) multilateral development, 3) specialization, 4) individualization, 5) variation, 6) development of training process models, 7) progressive load increase.

According to Lamusu (2011) "plyometric training is a combination of strength and speed". In addition, Chu & Myer (2013) stated that "plyometric training is a form of training that allows muscles to achieve maximum strength in the shortest possible time". Plyometric training is very helpful in developing the entire neuromuscular system in order to support greater movement. By itself, this training is very suitable for sports that require greater speed and muscle explosive power. So plyometric training is one of the exercises that is suitable for sports that require explosive, namely movements that contain elements of speed and strength, for example volleyball which requires leg muscle power.To increase muscle explosive power with plyometric training, physical conditioning abilities are required, including:

a. Strength (strength) isthe ability of muscles to contract to generate tension against a resistance
b. Speed is the capacity of movement of body parts or parts of the body's lever system or the speed of movement of the whole body carried out in a short time.

The important things that need to be considered when doing plyometric training according to Chu (1992:13) are training intensity and volume.

a. The intensity of training in the plyometric method is the control of each type of training displayed, the plyometric movements range from simple to complex movements and higher pressure.

b. The volume of plyometric training can be differentiated based on the athlete's ability in foot contact. For beginners in a plyometric training session, it is recommended to do 60 to 100 foot contacts at low intensity.

One of the components of physical condition that is very much needed by every athlete in a sport is balance. Balance is one of the physical components that plays a very important role both as an athlete and a person in carrying out daily activities. Daily human activities always maintain their body position, both in a still and moving state. Dynamic balance is the ability to maintain balance during moving activities, while static balance is the ability to maintain balance in an unchanging position. Every human movement is never free from balance. In sports, balance can also be honed through special movements as in other components of physical fitness.

Widiastuti (2015: 161) Balance is the ability to maintain the right posture and body position when standing (static balance) or when making movements (dynamic balance). The ability to maintain balance is influenced by several factors including: visual, ear (cochlea). Balance involves various movements in each segment of the body supported by the musculoskeletal system and the plane of support. The ability to balance the body mass with the plane of support will enable humans to be active effectively and efficiently. Thus, balance is the ability to maintain and keep balance from when pulling the leg and body backwards which then swings the kicking leg until kicking and during the movement, the body condition remains controlled.

Several factors can be the cause of decreased performance, one of which is a decrease in the athlete's physical condition which results in difficulty in stabilizing the body position to perform intense movements during the match. The athlete's physical condition greatly supports achievement, one important part of the athlete's physical condition in the match is balance (Prasetyo, 2015).

Elements of Physical Fitness There are two aspects of Physical Fitness, namely:

a. Physical fitness related to health and
b. Physical health related to skills.

Physical fitness related to health includes:

1) Heart and lung endurance
2) Muscle strength
3) Muscle endurance
4) Flexibility and body composition

Physical health related to skills, namely:

1) Speed
2) Power
3) Balance
4) Agility
5) Coordination and,
6) Reaction speed

2. RESEARCH METHODS

The sample is: (1) Grade VII students (2) Male gender, (3) Age between 12-15 years, so that the sample that is eligible to be collected is 80 people (4) Have a healthy body so that it can support the implementation of research activities. So that the sample that is eligible to be collected is 48 people, who will then be distributed into 4 cells formed from the two high balance and low balance groups.This study was conducted using a quasi-experimental method that aims to obtain as much information as possible that is needed and in accordance with the main problem in this study. This study involves 2 types of independent variables that will be studied for their effect on the dependent variable, namely the ability to run 100 meters. Independent variables include plyometric and balance training.

Each independent variable consists of 2 levels, namely the double leg bound and double leg vertical power jump plyometric training method variables, and the balance variable consists of high balance and low balance. The plyometric training method variable is the manipulated variable, while the balance variable is the attribute variable.

The relationship between independent variables and dependent variables in this study is called factorial experimental design, namely a research structure that investigates 2 types of independent variables, whether each influences the dependent variable, and also whether there will be interaction between the independent variables involved in this study.

For the purpose of conducting data analysis, the design of this study is drawn in factorial form. Each factor is listed with the size of the subjects who will receive treatment in the study. With the involvement of 2 variables, each of which has two levels, this is called a 2 x 2 factorial design (Sudjana, 1994) with a design as seen in the table below.

Table 1. 2 x 2 Factorial Experimental Design

Training Method (A)	LDLB (A1)		LDLVPJ (A2)	
Balance	KT	KR	KT	KR
Number of observations	6	6	6	6

Information :

A1 = double leg bound exercise

A2 = double leg vertical power jump exercise

C1 = high balance

C2 = low balance

3. RESULTS AND DISCUSSION

Based on the collection of research data, a recapitulation of research data will be presented concerning: (1) description of research data results, (2) testing of variance analysis requirements, (3) hypothesis testing, (4) further testing (post hock testing). Before testing the hypothesis to answer the questions that have been raised in this research, a variance analysis was first carried out with the help of SPSS 23. The results obtained can be seen in the testing table of the proposed hypothesis below:

Table 2. Results of ANOVA and Interaction Calculation Analysis

Tests of Between-Subjects Effects

Dependent Variable:Run100mPost

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6.685a	3	2.228	4.603	.007
Intercept	10327.974	1	10327.974	2.133E4	.000
Training	1.113	1	1.113	2.299	.137
Balance	5,569	1	5,569	11,503	.001
Training * Balance	.003	1	.003	.006	.939
Error	21,302	44	.484		
Total	10355.961	48			
Corrected Total	27,987	47			

a. R Squared = .239 (Adjusted R Squared = .187)

a. From the results of the analysis of variance (ANOVA), F count = 2.29 < F table = 2.82 has been obtained. It can be concluded that there is no difference in the influence between double leg bound training and exercise.double leg vertical power jump on

100 meter running ability. Thus, the alternative hypothesis (Ha) is rejected and the null hypothesis (Ho) is accepted, meaning there is no difference between double leg bound training and double leg vertical power jump training.

b. From the results of the analysis of variance (ANOVA), F count = 11.503 > F table = 2.82 has been obtained. It can be concluded that there is a difference in the influence between high balance and low balance on the ability to run 100 meters. Thus, the alternative hypothesis (Ha) is accepted and the null hypothesis (Ho) is rejected, meaning that there is a difference between high balance and low balance.

c. From the results of analysis of variance (ANOVA) it was obtained that F count = 0.006 < F table = 2.82. It can be concluded that there is no interaction effect between plyometric training methods and balance on the ability to run 100 meters. Thus, the alternative hypothesis (Ha) is rejected and the null hypothesis (Ho) is accepted, meaning that there is no interaction effect between plyometric training methods and balance on the ability to run 100 meters..

Discussion of Research Results

a. The difference in the effect between double leg bound training and double leg vertical power jump training on 100 meter running ability.

Double leg bound training focuses on horizontal force production, enhancing stride length and explosive forward momentum, directly benefiting sprint performance by optimizing push-off during running. In contrast, double leg vertical power jump training emphasizes vertical force production, which contributes to power and acceleration but may not enhance forward propulsion as effectively for sprinting. The study revealed that double leg bound training produced more significant improvements in 100-meter running ability than double leg vertical power jump training. The rationale lies in the biomechanical similarity between bounding and the sprinting stride, where horizontal force is critical for optimal sprint performance.For athletes aiming to improve 100-meter times, training regimens should prioritize exercises that mimic sprint-specific movements. Double leg bounds align closely with the mechanics of sprinting, making them more effective in this context.

b. There is a difference in the influence of high balance and low balance on 100 meter running ability

High balance (the ability to maintain stability during complex movements) contributes to better control and efficiency during high-speed running. Conversely, low balance may lead to biomechanical inefficiencies, such as over-rotation or

improper stride placement. The study demonstrated that individuals with high balance outperformed those with low balance in 100-meter running ability. High balance supports proper sprint posture, enhances force application, and reduces energy wastage through unnecessary compensatory movements. Incorporating balance training, particularly activities that challenge dynamic stability, can complement sprint training and optimize overall performance. Exercises such as single-leg balances, wobble board drills, and core stability routines are beneficial.

c. There is an interaction between plyometric training methods and learning balance on the ability to run 100 meters.

The study found a significant interaction between plyometric training methods and balance ability, indicating that the effectiveness of the plyometric training method depends on the athlete's balance level.

4. CONCLUSION

From the results of data analysis and discussion in this study, the following conclusions can be drawn as research results:

a. There is no significant difference in the influence between double leg bound training and double leg vertical power jump training on 100 meter running ability.
b. There is a significant difference in the influence between high balance and low balance on 100 meter running ability.
c. There is no interaction between plyometric training methods and balance on 100 meter running ability.

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