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The effect of 6 weeks of body weight training combined with ladder drill on the agility of 11-12 year old badminton athletes

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Abstract
This study aims to examine the effect of body weight training exercise combination ladder drill on the agility of badminton athletes. This research method is an experiment with the design of one group pretest-posttest design. The population used is all PB athletes. Sampling using purposive sampling technique with a total of 20 samples. The instrument to measure agility ability is a series of footwork tests.
Data analysis technique used is the t-test with a significant level of p<0.05.Conclusion: there is a significant effect on body weight training combined with ladder drill on the agility of badminton athletes aged 11-12 years after 6 weeks. Based on the results of the T-test analysis, the significant value is 0.000, so p<0.05. Then looking at the results of the descriptive data at the time of the pretest, the average was 16.6, then increased to 19.5 during the posttest.

Keywords: Body weight training, ladder drill, agility

Introduction
Badminton is the fastest racket sport in the world [1] as shuttlecock speeds can reach more than 250 km/h in elite level matches [2]. Thus, badminton is a sport that requires speed in changing direction, explosive movements, many reflex movements, and good motor skills [3]. Therefore agility, and leg muscle power are very important and necessary components in badminton games [4], Agility is very important in badminton athletes to make it easier to return shuttlecocks and build fast attacks on athletes. Experts note that speed and strength are determining factors for badminton athletes [5]. In addition, agility is also an important component in badminton [6].
There are nine important physical condition components in badminton, namely: 1) agility, 2) leg muscle Power, 3) Muscle Strength, 4) muscle endurance, 5) endurance, 6) flexibility, 7) Speed, 8) coordination, 9) balance [7]. All componentsare needed to support footwork techniques. Footwork is the movement of the feet that adjust the position of the body to match the position of the shuttlecock at the time of hitting the shuttlecock [8]. With good footwork, then the player can allow the athlete to move as efficiently as possible in all areas of the field.
Agility is one element of athletic ability that must be possessed by an athlete, because with agility an athlete can quickly and precisely change the direction and position of the body or its parts. Agility is very important in badminton because of the need to perform movements that can change the direction of body position quickly and accurately without losing balance and body position awareness [9]. Agility is a person's ability to move quickly and precisely without losing balance [10]. To successfully catch the shuttlecock and return it to the opponent's area, a badminton athlete must be able to master the field and move quickly and accurately in all directions. In order for badminton to move efficiently across the court, they need quick, agile, and agile leg movements [11].
However, in contrast to the situation on the ground, researchers found out on the basis of observations of one of the clubs in August 2022, that athletes still have difficulties when chasing shuttlecocks due to heavy footsteps.

Athletes often have difficulty turning their bodies and changing direction quickly without losing their balance, which makes them slow when chasing shuttlecocks and reduces hitting accuracy.

Every week athletes have received training for physical abilities to improve their physical abilities. Exercises such as shaddow, shuttle run, sprint, skipping, and circuit training are usually given, but do not provide sufficient stimulus to improve the agility of badminton athletes. This can happen due to improper exercise programs or the coach does not know how to create a program for the age of the children.

Therefore, to increase the agility of athletes age11-12 years should get the right exercise program. In addition, limited facilities hinder athletes from maintaining their physical condition. When performing physical exercises, the coach uses only used shuttlecock slops.

The fact that agility is very important in badminton shows that special training models are needed to improve agility. According to previous research plyometric and body weight training are two types of exercises that increase agility and strength of leg muscles [12]. However, plyometric exercises are not recommended for children because they can cause injury and inhibit their growth until adolescence. Plyometric exercises can only be performed by athletes who have a maximum strength foundation.

Athletes can use the ladder drill to train agility [13]. Breaking away from the ladder can increase intelligence, but this must be done in a different way so as not to become oversaturated. Ladder drill skills can be improved in children 11-13 years old [13]. This exercise is done three times a week for six weeks, or eighteen meetings each week. A follow-up study found that an eight-week, twice-daily ladder drill significantly improved leg muscle agility and power [14].

Body weight training is a type of weight training with your own body weight can be done without tools. As a result, the likelihood of injury is very low. Body pressure can increase the agility of the limb muscles and their strength. According to previous research, bodyweight training has a significant effect on the leg muscle strength of Yogyakarta handball athletes [15]. Therefore, the researcher created an exercise model to improve the agility of children so that they do not have injuries and do not hinder their development until adolescence.

Taking into account the above background and the findings of previous studies, researchers were motivated to conduct a study on badminton athletes who received a treatment consisting of body weight training combined with a ladder drill. The study was conducted three times a week for six weeks and concentrated on agility. Thus, the authors want to conduct experimental research with the title "The Effect of 6 Weeks of Body Weight Training Combined with Ladder Drill on The Agility of 11- 12 Year Old Badminton Athletes"

Materials and Methods

This study used a one-group pretest and posttest design, which means that the experiment was conducted on one group without a comparison group. This design is a study conducted twice, namely before the experiment (pretest) and after the experiment (posttest), with one group of subjects. Thus it can be known more accurately because it can compare before treatment with after treatment [16]. This study will compare the pretest and posttest results of agility of badminton athletes aged 11-12 years old.

Table 1: One group pretset-posttest design

Pretest	Treatment	Posttest
O_1	X	O_2

Description

O_1: Pretest of agility results
X: Giving body weight tretamen combination ladder drill
O_2: Posttest agility results

This research was conducted at Gor Jagalan and Gor Sorowajan where PB. Pratama. The research time was conducted from September 23, 2023 to November 04, 2023. The treatment lasted for 6 weeks with a frequency of 3 times a week.

The population used in this study were badminton athletes at PB. Pratama Yogyakarta which amounted to 70 people. Samples taken using purposive sampling technique. The criteria are:

a) At least follow badminton training for 1 year.
b) Children aged 11-12 years.
c) Not in a state of illness / injury.
d) Willing to follow the rules in the treatment applied.

Based on these criteria, the number of athletes who meet is 20. Measurement of agility is done with the Footwork Test this test has a validity of 0.98 and a reliability of 0.93 [18]. The implementation of doing the circuit foot test is that the first testi is in a rectangular box in the middle. When there is a "start" signal the testi starts moving and one leg must enter the square box number 1. After that the thesis returns to the center like the initial position, then moves back to box number 2. So on in order of number. The implementation of this test is carried out for 30 seconds, then the value is obtained based on the total number of feet stepping into the box.

Results and Discussion

Description of research data: The results were obtained from data pretest and posttest events. The research will be conducted in three stages. First, a pretest was conducted on September 23, 2023 to obtain pretest data. The second stage is to give treatment, which lasts for one month and two weeks (from September 24, 2023 to November 4, 2023). Then the last stage is done posttest.

Table 2: Data Pretest dan Posttest of Agility

No.	Pretest	Posttest
1	21	25
2	20	25
3	20	24
4	19	23
5	19	23
6	18	22
7	17	21
8	17	21
9	16	20
10	15	20
11	19	21
12	17	19
13	16	19
14	16	18

According to Table 2 Above, the average agility at the time of pretest was 16.7 and increased by 19.95 then there was an average difference of 3.25.

Descriptive statistics pretest and posttest agility are presented in Table 2 as follows.

Table 3: Descriptive statistics pretest and posttest of agility

Result	Minimum	Maximum	Mean	Std. Deviation
Pretest	13	21	16,6	2,3
Posttest	25	25	19,95	3,1

When displayed in the form of a diagram, the results of agility data are presented in Figure 1 as follows.

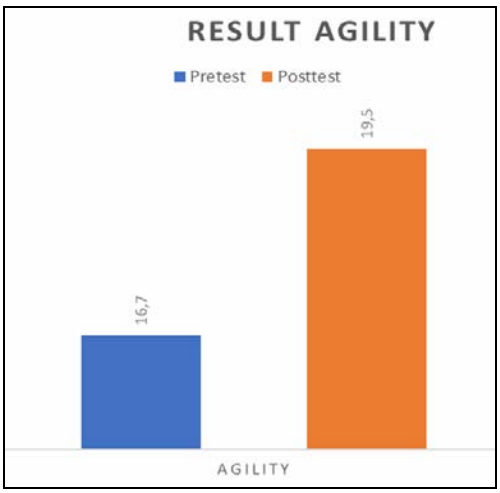

Fig 1: Diagram Pretest and Posttest of Agility

Result of Pre-Requisite Test

A. Test of Normality

In this study, data normality test was used with Shapiro wilk test. Data normality test was conducted in each Analysis Group with a significance level of 5% or 0.05. The summary is presented in Table 4 as follows.

Table 4: Test of normality

Tests of Normality						
Kolmogorov-Smirnov[a]				Shapiro-Wilk		
Statistic		df	Sig.	Statistic	df	Sig.
Pretest of Agility	.132	20	.200*	.943	20	.276
Posttest of Agility	. 098	20	.200*	.954	20	.431

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Since the number of samples is less than fifty, a normality test with the Shapiro Wilk test has been used. Table 4 above shows that the pretest and posttest agility data were obtained from the normality test data, with a significance value of $p>$ 0.05, which indicates that the data are normally distributed.

B. Test of Homogenity

Homogeneity test is intended to test the similarity of variants between pretest and posttest. Homogeneity test in this study is the Levene Test. Test results homogeneity is presented in Table 5 as follows

Table 5: Test of homogeneity

Test of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
Agility	Based on Mean	1.452	1	38	.236
	Based on Median	1.403	1	38	.244
	Based on Median and with adjusted df	1.403	1	35.010	.244
	Based on trimmed mean	1.456	1	38	.235

Each agility pretest and posttest data were derived from a significance value p greater than 0.05, as shown by statistical analysis of homogeneity tests performed using the Levene test for equality of variable error test. Table 5 above shows these results. The result shows that the population has the same homogeneity or variance because the Data Group has homogeneous variance.

Result of Hypotesis test

Hypothesis testing was conducted based on the results of data analysis and interpretation of the Test T test. Hypothesis in the study is the effect of body weight training combination of exercise on the agility of badminton athletes aged 11-12 years. Test criteria if sign value. < 0.05, then Ha is accepted. Hypotheses that will be put forward in the study are:

H_o: There is no significant change in body weight training combined with ladder drill training on agility.

Ha: There is a significant change from body weight training combined with ladder drill training on agility.

Based on the results of the T-test analysis, the data in table 6 are as follows.

Table 6: Result of T-test

Paired Samples Test									
Paired Differences									
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	Pretest of Agility- Posttest of Agility	-3.250	1.070	.239	-3.751	-2.749	-13.585	19	.000

From the T-test results in Table 6 above, it can be seen that the significance value of p is 0.000, then <0.05, then HO is rejected. Thus, it means that there is a significant effect on the combination of body weight training exercises on agility. At the time of pretest average of 16,6, then increased to 19,5 at the time of posttest. This demonstrates the validity of the study which states, "There is a significant effect of ladder drill combined body weight training exercises on agility." it has been proven.

Body weight training is weight training that uses the body's own body weight as a load. This exercise can be performed without the use of special equipment, so it can be performed anywhere and at any time. Body weight training exercises can provide various benefits, including:

a) Increases muscle strength and endurance
b) Increase flexibility and mobility
c) Improves balance and coordination
d) Increase muscle mass
e) Improves metabolism
f) Reduce the risk of injury

In this study the type of body weight training provided in the form of sit ups, back ups and lunges. The following muscle targets will be trained by body weight training, namely:

a) Sit ups, muscle targets in sit ups are the front abdominal muscles, especially the rectus abdominis muscle. The rectus abdominis muscle is a muscle that runs along the front of the abdomen, from the sternum to the pubic bone. This muscle plays a role in bending the body forward, turning the body, and holding the stomach.
b) Back up, the target muscles on the back up are the lower back muscles, especially the erector spinae muscles. The erector spinae muscle is a muscle that runs along the spine, from the cervical vertebrae to the sacrum bones.
c) Lunges, target muscles in lunges are quadriceps muscles, hamstrings muscles, and gluteus muscles. The quadriceps muscle (quadriceps) is a muscle located on the front of the thigh.

Body weight training can affect the agility through several mechanisms, namely

a) Increases leg muscle strength
The strength of the leg muscles is one of the factors that determine the agility and power of the leg muscles. Strong leg muscles will be able to produce greater power in a short time, so as to increase the speed and ability to change the direction of the body.

b) Increases the speed of muscle contraction
The speed of muscle contraction is also an important factor that determines the agility and power of the limb muscles. Muscles that can contract quickly will be able to produce greater power in a short time. Body weight training can increase the speed of muscle contraction through movements that involve weight transfer. These movements involve a sudden transfer of body weight, so as to train the muscles to contract quickly.

c) Improves muscle coordination
Muscle coordination also plays an important role in the agility and power of the leg muscles. Well-coordinated limb muscles will be able to work together effectively to produce efficient movements. Body weight training can improve muscle coordination through complex movements. These movements involve the transfer of body weight and rapid changes in body direction, so as to train the brain to coordinate the movements of the muscles of the limbs.

According to research conducted in 2019 found that a significant percentage of increased agility was obtained at 12.08%, and a significant percentage of increased power was obtained at 9.81%, the results explained that there was a significant increase in agility and power after being given exercise circuit bodyweight training methods. Exercise body weight training combination ladder drill will provide stimulation to the leg muscles to adjust and improve their function, so that this exercise can increase the agility and power of the leg muscles [18].

Ladder drill is one of the tools in the form of a ladder placed on the surface of the ground or field aims to improve footwork and train agility. Ladder drill exercise is an exercise that focuses on the movement of the legs, so that the main muscle targets are the leg muscles, including:

a) The quadriceps muscle, which is the quadriceps muscle that plays a role in knee extensor movements.
b) Hamstring muscles, which are the hamstrings muscles that play a role in the movement of the knee flexors.
c) Gastrocnemius muscle, which is the calf muscle that plays a role in the flexion plantar movement of the ankle.
d) The soleus muscle, which is the calf muscle that plays a role in the flexion plantar movement of the ankle.

In addition to the leg muscles, the ladder drill can also train the following muscles

a) The core muscles (cores), which are the muscles that surround the spine and pelvis.
b) The core muscles play an important role in maintaining the stability of the body.
c) The shoulder muscles, which are the muscles that play a role in shoulder movement.

Ladder drill provides training with fast and dynamic leg movements, so the body moves faster and more agile. In addition, a good ladder drill exercise increases the strength of the leg muscles, which can result in greater strength. According to another study conducted in 2021 about found there is a significant difference between core exercises and ladder drills on the agility of basketball players. This is indicated by the value of $F = 5.123$ and the value of $p = 0.038 < 0.05$, which indicates that the ladder drill training group has a higher level of agility (good) compared to the core training group [19].

With regular exercise, the number and size of myofibrils, the density of capillary blood vessels, tendon nerves and ligaments, and the total number of contractiles, especially the contractile protein myosin, will increase. Each muscle fiber undergoes changes at different rates. The White muscle fibers, known as fast-contracting muscle fibers, undergo an increase in size, which in turn results in a higher speed of muscle contraction, which in turn results in greater agility. It can be concluded that body weight training and ladder drill exercises are types of exercises that can increase agility and strength of leg muscles. While a ladder drill can improve coordination, control, speed, and strength of leg muscles.

According to development children are divided into two groups: 6-10 years old (multilateral) and 10-12 years old (lateral). To develop a child's basic movements, exercises are performed at the multilateral stage. In the next step, the exercises are focused on specific sports. While in the next stage, the exercises are specialized in certain sports. Basic footwork techniques are very important for children's badminton players, especially those between the ages of six and twelve, as they are essential for improving the efficiency of their steps while playing. Every player must learn footwork techniques to avoid being swayed by their opponents.

Children at this age need extra attention from their coaches. Training should be appropriate to their nature. Athletes prepare themselves for more strenuous training and use a variety of proper techniques and skills when starting their training [20]. At this level, the training structure is comparable to that of senior players. The technical part of the training is the most important. Understanding basic tactics and creating new techniques are two excellent examples of this ability [21].

Doing regular exercise activities causes the size of muscle fibers to become larger, which means that the diameter of the

muscles becomes larger. Therefore, the strength and endurance of the muscles increase in order to protect the joints from injuries caused by increased external loads. In addition to increasing the number of blood vessels, the diameter of muscle fibers, and intracellular organelles, exercise also increases muscle strength. Only then will there be a significant improvement if you practice regularly for two months. This increase in strength must be maintained because if you do not train for the next five months, this increase will disappear completely.

There are many types of muscle training, in general, it can be divided into two activities. First, static exercises involve muscle contraction but do not produce movement in the joints. Second, dynamic exercises involve muscle contraction but do not produce movement in the joints. Dynamic exercises involve two types of movements: concentric movements, in which the limb approaches the body, and eccentric movements, in which the limb moves away from the body. In both movements, lengthening and shortening occur at the same time.

The nature of the muscles affected by the two types of training above is not the same, but the basis for the changes is the same. Static exercises can reduce the speed of movement, slowing down the movement of the muscles in question. Dynamic exercises, on the other hand, can increase muscle strength or maintain strength at a certain level without reducing movement speed. Exercise body weight training combination ladder drill in the study is a strength and speed training and includes a type of dynamic exercise, where there is a cosentric movement of the limbs approaching the body, and eccentric movement, where the limbs away from the body.

Around the age of twelve, when rapid growth begins, agility continues to increase. After a period of rapid growth, agility not only increases but also decreases. After rapid growth, agility increases again until adulthood and then decreases again in old age. If given in adolescence (10-18 years for females and 12-20 years for males), physical condition training will be beneficial [22]. Since regular exercise will increase muscle strength at this age, this age is very important for increasing muscle explosive strength.It will reach optimal muscle maturity at the age of twenty to thirty years [23].

Conclusion

Based on data analysis, hypothesis testing, and discussion in the previous chapter, this study found that " There is a significant influence of the body weight training model combination of ladder drill on the agility of badminton athletes aged 11- 12 years after being treated for 6 weeks.

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