The effectiveness of lateral box shuffle plyometric exercise on increasing limb muscle power of badminton athletes

Eficacia del ejercicio pliométrico de barajado lateral en el aumento de la potencia muscular de las extremidades de los atletas de bádminton

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Abstract

Introduction: The problem in this study is the low muscle power ability of badminton athletes.
Objective: This study aims to determine: 1) the effect of pliyometric lateral box shuffle training on increasing leg muscle power of badminton athletes. 2) the difference in the effect of pliyometric lateral box shuffle training between the treatment group and the control group on increasing leg muscle power.
Methodology: This type of research is an experiment with pre test and post test control group design. The sample in this study amounted to 78 athletes who were taken using random sampling technique. The subjects were divided into 2 groups, namely the treated group of 44 athletes and the control group of 36 athletes. The instrument used is to measure leg power, namely the vertical jump test. The data analysis technique used is the independent sample t test and continued with the paired sample t-test.
Results: The results showed that: 1) There is a significant effect of lateral box shuffle training on increasing leg muscle power with a significance value smaller than 0.05 ($p<0.05$). 2) There is a significant difference in influence between the group given treatment and the control group on increasing leg muscle power, as evidenced by the mean value of leg muscle power in the treatment group of 95.71 kg m/s while the mean value of leg muscle power in the control group is 78.93 with an average difference in post test of 16.78 kg m/s.
Conclusions: The group that was given the treatment had better leg muscle power compared to the control group that did not receive treatment.

Keywords

Lateral box shuffel; leg muscle power; badminton.

Resumen

Introducción: El problema de este estudio es la baja capacidad de fuerza muscular de los atletas de bádminton.
Objetivo: Este estudio pretende determinar: 1) el efecto del entrenamiento pliométrico del box shuffle lateral en el aumento de la potencia muscular de las piernas de los atletas de bádminton. 2) la diferencia en el efecto del entrenamiento pliométrico lateral del box shuffle entre el grupo de tratamiento y el grupo de control en el aumento de la potencia muscular de las piernas.
Metodología: Este tipo de investigación es un experimento con diseño de grupo de control pre test y post test. La muestra de este estudio ascendió a 78 atletas que se tomaron mediante la técnica de muestreo aleatorio. Los sujetos se dividieron en 2 grupos, a saber, el grupo tratado de 44 atletas y el grupo de control de 36 atletas. El instrumento utilizado para medir la potencia de las piernas es el test de salto vertical. La técnica de análisis de datos utilizada es la prueba t de muestras independientes y continuó con la prueba t de muestras emparejadas.
Resultados: Los resultados mostraron que: 1) Existe un efecto significativo del entrenamiento del box shuffle lateral en el aumento de la potencia muscular de las piernas con un valor de significación inferior a 0,05 ($p<0,05$). 2) Existe una diferencia significativa en la influencia entre el grupo que recibió el tratamiento y el grupo de control sobre el aumento de la potencia muscular de la pierna, como lo demuestra el valor medio de la potencia muscular de la pierna en el grupo de tratamiento de 95,71 kg m/s mientras que el valor medio de la potencia muscular de la pierna en el grupo de control es de 78,93 con una diferencia media en el postest de 16,78 kg m/s.
Conclusiones: El grupo que recibió el tratamiento presentó mejor potencia muscular en las piernas en comparación con el grupo control que no recibió tratamiento.

Palabras clave

Box shuffel lateral; fuerza muscular de las piernas; bádminton.

Introduction

Sports achievements are obtained through a systematic and measurable process of coaching and training. Sports achievement cannot be separated from the element of good physical condition. To achieve high performance in competitive sports, an athlete really needs prime physical condition according to the needs and demands of the sport (Cowden, 2017; Kuczek, 2013; Ring & Kavussanu, 2018). Physical condition determines the quality and ability of the player because with good physical condition, a player is able to concentrate fully in the game. Physical condition is the most important factor in a training program that aims to achieve high abilities (Andreato et al., 2017; Slimani et al., 2016). Physical condition is a whole unit of interrelated components. One sport that requires excellent physical condition is badminton.

Badminton is a game sport that has complex movement skills (Ab Rashid et al., 2022; Ahmed et al., 2022; Bravo-Sánchez et al., 2021) . The results of the literature review state that badminton has movement characteristics such as sudden stops, jumping, running while changing direction quickly without experiencing fatigue and having a stable balance (Ihsan et al., 2023). Therefore, physical condition is an important point for badminton athletes. The components of physical condition involved in badminton are speed, agility, muscle power, balance, strength, and coordination. One of the most important physical components in badminton is power. This is also supported by previous research (Pratama, 2020) revealed that the biggest contribution when doing smash is leg muscle power. If athletes have good leg power, they will get maximum smash results. In badminton games athletes must jump to be able to smash, this means that the working muscles must be able to contract maximally in a very short time.

However, in reality, based on the results of observations made by researchers in November 2023 at the badminton gym building in Sleman, the coach revealed that the smash ability of badminton athletes is still low when compared to the ability to serve, even though if a badminton athlete can master a good smash technique, it will be easier to get points. Researchers get the latest data in the field from badminton coaches when athletes do the leg power test with the vertical jump test showing that the average jump height is 24 cm, these results fall into the category of less. The ongoing training program is also still lacking in training athletes' leg power. More training is practiced, aerobics, and service techniques. So that cardiovascular endurance is not balanced with the athlete's muscle power. If this continues to be allowed it will affect the decline in athlete achievement.

Power is very important in badminton, especially in smash techniques because without good muscle strength and speed, a good smash technique will not be created, and vice versa with good muscle power, a good smash technique will be created. Research (Akbari et al., 2018) shows that there is a contribution of leg power to smash results in badminton, this is because when athletes jump during smash it is less fast and less strong so they cannot perform smash attacks optimally.

The lack of smash ability in badminton is influenced by the lack of training on power. Strength and power in smash techniques, apart from being used for the prefix, are also used when releasing racket blows. The strength and speed of the feet when jumping to produce great power needs to be combined with coordination of other limbs. Leg muscle strength greatly affects the results of the prefix, when going to do the smash technique. The smash technique is also supported by muscle strength and speed when hitting the shuttlecock. Support at the time after performing the smash technique also requires maximum leg strength, so that the momentum of explosive power can be channeled properly.

The smash technique movement must be supported by muscle contractions, besides that it is a supporting factor because in the smash technique there is a forward body repulsion movement. Each individual has a different level of strength so that the results obtained in the smash technique for each individual will be different. Leg power is needed in performing smash techniques, and muscle strength also has an important role in the success of the smash technique which will provide important energy for repulsion. Large muscle power will allow someone to do a more targeted smash, so that it can produce maximum performance. (Nasrulloh & Wicaksono, 2020) say that muscle strength can be trained by paying attention to the number of sets in each training session.

Training is a process in sports activities to develop the potential that exists in athletes, especially in the abilities and skills possessed systematically and carried out according to a predetermined period of time (Posadzki et al., 2020). Pliometric exercise is to combine strength and speed to produce a leap of power,

also the nature of muscle elasticity causes some functional adaptation of muscles, so that muscle coordination is better and can make the strength more explosive. (Asadi et al., 2016; Kuibida et al., 2021; Ristic, 2017) explains that plyometric training provides the stimulus needed and can increase explosive contractions.

Pliometric exercises are used to increase lower body muscle power and improve explosive power by training muscles to do more work in less time (Makhlouf et al., 2018). To increase leg muscle power there are many variations of pliyometric exercises, one of which is by providing lateral box shuffle pliyomteric exercises. The lateral box shuffle exercise is a pliyometric exercise for the lower body. Lower body is the lower body. The scope trained in the exercise is expected to increase leg power. Nasrulloh & Wicaksono, (2020) that the increase in muscle work ability due to exercise is caused by physiological changes that occur in the neuromuscular system (adaptation of the neuromuscular system). Increased muscle strength causes stronger muscle contractions (increased power), faster repetition of contractions (increased speed), and longer lasting exercise periods (increased muscle endurance). The purpose of this study was to determine the effectiveness of lateral box shuffle pliometric training on the leg power of badminton athletes.

Method

Study Design

This study used a quasi-experimental research model with a pre test and post test control group design. This experimental research uses 2 different groups, namely the treatment group and the control group or not given treatment.

Participants

The research was conducted from December 2023 in Yogyakarta sleman. The population in this study amounted to 78 athletes, and the sample in this study amounted to 44 athletes. Sample withdrawal technique using random sampling technique. This study has obtained approval from all samples who have filled out a statement of ability to become research samples and have met the requirements of the research ethics code.

Procedure

Data collection techniques in this study were tests and measurements. The instrument to measure leg power as taking the initial test or pre test is using a vertical jump with a validity value of 0.978 and a reliability value of 0.989 (Sepdanius et al., 2019). After that, treatment or training is given 24 meetings with a frequency of 3 x a week. And ended with taking the final test or post test to measure leg power using a vertical jump board with the aim of knowing the difference in leg power scores after treatment / treatment.

Data analysis

The data analysis technique used in this study using SPSS 24 is to use the Independent Sample t Test and continued paired sample t test at the sig level. = 0,05. Before arriving at the utilization of paired sample t-test, it is necessary to conduct a prerequisite test, which includes: (1) normality test and (2) hypothesis testing with paired sample t-test.

Results

In the research results and discussion section will be presented sequentially, among others: Prerequisite test results, and hypothesis testing. Hypothesis testing in this study will be presented in accordance with the formulation of the problem, namely: (a) The effect of lateral box shuffle pliometric training on increasing leg power in badminton athletes. In full will be presented as follows. (b) The effect of the difference in the effect of lateral box shuffle pliometric training between the treatment group and the control group on increasing leg muscle power.

Prerequisite Test Results

Normality Test

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

Treatment Group

Table 1. Summary of Treatment Group Normality Test Results

Group	P	Significance	Information
Pre test Limb muscle power	0,453	0,05	Usual
Post test Limb muscle power	0,608	0,05	Usual

Based on the statistical analysis of the normality test that has been carried out using the Kolmogorov Smirnov test, in all pretest and posttest data of the treatment group, the results of the data normality test obtained a significance value of p> 0.05, which means that the data is normally distributed.

Control Group

Table 2. Control Group Pre Test Data Normality Test Results

Data	P	Significance	Information
Pre test Limb muscle power	0,319	0,05	Usual
Post test Limb muscle power	0,342	0,05	Usual

Based on the statistical analysis of the normality test that has been carried out using the Kolmogorof Smirno test, the pretest and post test data of the control group are obtained from the results of the data normality test, the significance value p> 0.05, which means that the data is normally distributed, it can be concluded that all pre-test and post-test data in the control group are declared normal.

Homogeneity Test Results

The homogeneity test is used to test the similarity of variance between the data being compared. The results of the pre-test and post-test data homogeneity test between the treatment group and the control group of this study are as follows.

Table 3. Homogeneity test results of pre-test and post-test data

	Group	F count	*p*	Information
Pre test of leg muscle power	Treatment Control	0,139	0,710	Homogeneous
Post test Leg muscle power	Treatment Control	0,527	0,471	Homogeneous

The results of the homogeneity test to test the equality of variance of the pre test post test data between the treatment group and the control group. Because the significance value is greater than 0.05 (p>0.05), it can be stated that the pre-test and post-test data between the treatment group and the control group are homogeneous.

Effectiveness Test Results

1) Independent Sample t Test Results

a) Pre Test

The results of the independent sample t test on the pre-test data compared between the treatment group and the control group are as follows.

Table 4. Results of Independent Sample t test Data Pre Test

Data	Group	Mean	t count	*p*	Information
Leg muscle power	Treatment Control	92,62 77,22	1,287	0,203	Significant

Based on the results of the Independent Sample t test analysis of leg muscle power data, the t value is 1.287 with a significance value of 0.203. Because the significance value of 0.203 is greater than 0.05 (p>0.05), it can be concluded that there is no significant difference in leg muscle power between the treatment group and the control group during the pre-test. This means that both groups have the same leg muscle power before being given treatment in the treatment group.

Based on the results of the analysis, the mean value of cardiovascular endurance in the treatment group was 92.62 kg m/s while the mean value of leg muscle power in the control group was 77.22 kg m/s. This means that the treatment group has a better mean leg muscle power compared to the control group who did not receive treatment.

b) Post Test

The results of the independent sample t test on post test data comparing the treatment group with the control group are as follows.

Table. 5 Independent Sample t test Results Post Test Data

Data	Group	Mean	t count	P	Information
Leg muscle power	Treatment Control	95,71 78,93	2,251	0,014	Significant

Based on the results of the Independent Sample t test analysis of cardiorespiratory endurance data, the t value is 2.251 with a significance value of 0.014. Because the significance value of 0.000 is smaller than 0.05 (p<0.05), it can be concluded that there is a significant difference in leg muscle power between the treatment group and the control group.

Based on the results of the analysis, the mean value of leg muscle power in the treatment group was 95.71 kg m/s, while the mean value of leg muscle power in the control group was 78.93 kg m/s. This means that the treatment group has better leg muscle power compared to the control group who did not receive treatment.

a) Paired Sample t Test ResultsTreatment Group

Table 6. Paired Sample t test Results Treatment Group

Data	Group	Mean	t count	P	Information
Leg muscle power	Pre test Post-test	92,62 95,71	4,003	0,001	Significant

Based on the results of the Paired Sample t test analysis of leg muscle power data, the t value is 4.003 with a significance value of 0.001. Because the significance value of 0.001 is smaller than 0.05 (p<0.05), it can be concluded that there is a significant difference in leg muscle power during the pre-test and post-test in the treatment group. This means that there is a significant increase in leg muscle power before and after treatment.

b) Control Group

Table 7. Control Group Paired Sample t-test results

Data	Group	Mean	t count	P	Information
Leg muscle power	Pre test Post-test	77,22 78,93	0,711	0,483	Significant

Based on the results of the Paired Sample t test analysis of cardiorespiratory endurance data, the t value is 0.711 with a significance value of 0.483. Because the significance value of 0.483 is greater than 0.05 (p>0.05), it can be concluded that there is no significant difference in leg muscle power during the pre-test and post-test in the control group.

Discussion

The discussion of the results of this study provides further interpretation of the results of the data analysis that has been stated. Based on hypothesis testing, there are three groups of analysis conclusions, namely: 1) there is a meaningful influence on the main factors of the study. 2) there is a difference in the effect of lateral box shuffle pliyometric exercise between the treatment group and the control group on increasing leg muscle power. The discussion of the results of the analysis can be further described as follows.

The difference in the effect between lateral box shuffle pliometric training on increasing leg power in badminton athletes.

Based on hypothesis testing, it is known that there is a significant effect of lateral box shuffle pliometric training on increasing leg power in badminton athletes. In accordance with biomechanical analysis, the lateral box shuffle movement involves more muscle groups in the lower limbs. The lateral box shuffle movement provides more load for the hip, leg and lower back muscles, and also involves the muscles that balance the knee and ankle. This finding is supported by several previous studies (Deng et al., 2023). The single-leg jumping progression was more effective than the double-leg jumping progression. This finding is consistent with some previous evidence (Novita et al., 2022) lateral box shuffle training is more effective for increasing leg muscle power. Recent findings support the hypothesis that single-leg jump and double-leg jump exercises using boxes can increase leg muscle speed and explosiveness (Gjinovci et al., 2017) argues that lateral box shuffle training which is carried out for 6 weeks with details of training 3 times in 1 week in a disciplined manner and in accordance with the training program that has been prepared, this exercise will greatly help significantly increase leg muscle power needed in various sports.

According to (Ayed et al., 2023) Lateral box shuffle training provides a significant increase in leg muscle explosive power. This is supported by previous research (Sabillah et al., 2022) which reveals that box shuffle pliometric training is more effective than box jump training on increasing leg muscle power. The lateral shuffle pliometric exercise develops leg and hip muscles, especially the gluteals, gastrocnemius, bicep femoris, gluteus, brevis soleus, extensor digitorum, and vastus lateralis with high speed and full power. (Nur et al., 2022). This exercise requires more weight for the hip, leg and lower back muscles, and also involves the muscles that balance the knee and ankle. This occurs because in its implementation only uses one leg where the weight in the exercise is only supported by one leg on the box while jumping sideways while the other leg is on the floor while following the flow of the jumping movement, so it also requires the role of the knee and ankle balancing muscles to maintain balance during exercise.

Damasco & Greco, (2020) Pliometrics is a training technique used by athletes that can be observed and plyometric training can also be done in all types of sports to increase strength, explosive power that is safe and effective for children and adolescents. Behm et al., (2017) states with the adaptation of plyometric training, the neuromuscular system is conditioned to react more quickly to the stretch-shortening cycle (SSC). Muscle contraction is very strong which is a response to dynamic loading or rapid stretching of the muscles involved. The effects of muscle hypertrophy will result in an increase in leg muscle strength. This statement is reinforced by the results of research from Maenhout et al., (2016) which states that the increase in muscle strength is due to Increasing the number of contractile proteins, actin and myosin filaments and increasing the strength of connective tissue and ligaments. In addition to increasing leg muscle strength, leg muscle speed will also increase with jumping movements that are done quickly and repeatedly. So that with an increase in muscle strength and leg muscle speed, it will directly affect the increase in leg muscle explosive power. This is based on two important elements in explosive power, namely muscle strength and muscle speed.

The effect of differences in lateral box shuffle pliyomteric exercise between the treatment group and the control group on improving cardiovascular endurance

The results of the analysis showed that there was a significant difference in the effect between the treatment group and the control group on increasing the leg muscle power of badminton athletes sleman yogyakarta. The group of students who were given the lateral box shuffle treatment was better than the control group on increasing leg muscle power. This is supported by the results of previous research (Yuniana et al., 2024) said that the experimental group had significant differences in all physical fitness variables when compared to the control group. Therefore, it is concluded that eight weeks of pliyomteric exercise can increase leg muscle power.

Conclusions

Based on the results of data analysis using the Independent Sample t test and continued with the Paired Sample t test, the conclusions of this study are: a) there is a significant increase in leg muscle power before and after treatment, and there is no significant increase in the control group, b) the group given the lateral box shuffle exercise treatment has better muscle power compared to the control group who did not receive treatment. Implications of the research results that to increase leg power can be done by seeking the application of lateral box shuffle. This means that athletes are given a training model that suits their characteristics so that in the training process athletes feel motivated to follow the training process, so that training goals will be achieved. Then another implication is that by encouraging coaches to apply suitable training methods can trigger athlete involvement in training.

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Conflict of Interest

The author has no conflict of interest regarding the author or results of other studies.

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