Journal RESPECS (Research Physical Education and Sport)
Volume 5, Number 2, 2023, pp. 411-417
DOI: https://doi.org/10.31949/respecs.v5i2.5982
p-ISSN: 2654-5233
e-ISSN: 2654-7112

The Effect of Plyometric Box Jump and Hurdle Hopping Exercises on Limb Muscle Explosive Power in a High School Volleyball Team

Felinda Sari[1ABCDE], Eka Pratiwi Yunianti[2D], Satria Armanjaya[3C]

[123]Physical Education Study Program, Faculty of Teacher Training and Education, Aisyah Pringsewu University, Lampung.
*Coresponding Author: felindasari2121@gmail.com

Authors' contribution: A) Conception and design of the study; B) Acquisition of data; C) Analysis and interpretation of data; D) Manuscript preparation; E) Obtaining funding

ABSTRACT
Leg muscle strength is needed in volleyball. The purpose of this study was to determine the effect of plyometric box jump and plyometric hurdle hopping exercises on the explosive power of the leg muscles in the volleyball team at SMA Negeri 1 Sumberejo. The method used is experimental. The sample used was 30 students. Data analysis using prerequisite tests and t tests. The results showed that the effect of the plyometric box jump exercise t count was -7.63 > t table = 1.753, and the effect of the plyometric hurdle hopping exercise t count was -10.21 > t table = 1.753. It was concluded that the plyometric box jump and plyometric hurdle hopping exercises had an effect on the muscles and limbs of the volleyball team of SMA Negeri 1 Sumberejo. Of the two exercises, the plyometric hurdle hopping exercise has a greater effect when compared to the plyometric box jump, or it can be concluded that there is no difference between the two exercise treatments.

ARTICLE HISTORY
Received: June, 2023
Accepted: June, 2023
Publish: July, 2023

KEYWORDS
Box Jump;
Hurdle Hopping;
Leg Muscles.

How to Cite : Sari, F., Yunianti, E. P., & Armanjaya, S. (2023). The Effect of Plyometric Box Jump and Hurdle Hopping Exercises on Limb Muscle Explosive Power in a High School Volleyball Team. *Journal RESPECS (Research Physical Education and Sport*, 5(2), 411-417. https://doi.org/10.31949/respecs.v5i2.5982

INTRODUCTION

Exercise is an important activity to train one's body physically and mentally and is useful for increasing the body's immunity to maintain health (Ramadani, 2017). Sports are used as a means of health, a means of recreation, and also as an achievement. With good sports achievements, the self-esteem or dignity of a nation will be better in the eyes of other nations or countries. It takes work to achieve; there must be serious effort and hard work from all parties involved in it, including players, coaches, and other supporting factors. Sport

is a competitive physical activity; one of the competitive sports is volleyball (Solehudin, 2021).

The volleyball game was invented by William G. Morgan in 1985; he was a physical education coach at the Young Men's Christian Association (YMCA) in the city of Helyoke in the United States. This game originally only aimed to meet recreational needs in a closed field (indoor), which can be played together by a large enough number of people (Rudiana et al., 2021). Volleyball is a complex game that is challenging for everyone to play. It requires knowledge of basic and advanced techniques to play volleyball effectively. These techniques include service, passing, smashing, and blocking (Apriyanti & Wahyudi, 2021). The popularity of this sport can be seen from the field facilities in rural communities, cities, schools, and others. Teenagers, youth, and adults favour this volleyball game because it is also fun and makes the body healthy (Nugraheni et al., 2017). The movements contained in the game of volleyball consist of elements of movement that are born in the form of basic techniques of the game of volleyball.

In reality, the process of playing volleyball is the application of a chain of game techniques that are closely related to service, passing, smash, and block. In a volleyball game, the main thing that each player must master is the ability to perform well and accurate volleyball playing techniques (Suhairi & Arifin, 2022). To have the ability to play volleyball techniques well, we must practice with the right exercises, for example, plyometric box jumps and hurdle hopping.

In simple terms, training can be formulated with all the power and effort to improve the overall physical condition through a systematic and repetitive process with increasing training load, time, or intensity (Saifuddin, 2017). Someone exercises because it is a form of effort to achieve a goal. "Exercise or training is a systematic process of practicing or working that is done repeatedly by increasing the amount of exercise or work (Bachtiar & Kastrena, 2019). "Thorough training provides the possibility of more stable development for the formation of achievements over time. The main purpose and goal of exercise or training is to help athletes improve their skills and achievements as much as possible. To achieve this, "there are four aspects that need to be considered and trained carefully by athletes, namely: (a) physical training; (b) technical training; (c) tactical training; and (d) mental training.

Plyometrics are exercises or repetitions that aim to connect speed and strength movements to produce explosive movements. This form of exercise is often used in connecting repetitive jumping and jumping movements or stretching reflex exercises from the muscles involved to produce explosive reactions quickly and dynamically before the muscles contract again (Arif & Alexander, 2019). The concept of plyometric exercise is carried out based on three muscle groups quickly before eccentric contraction of the same muscle, namely: 1) exercises for the lower limbs (limbs and hips), 2) exercises for the trunk (togok), and 3) exercises for the upper limbs (chest and arms). According to Radcliffe and Farentinous, there are two most important factors in plyometric exercise, namely: Elasticity of the muscle component, which includes the tendons and characteristic cross-bridges in actin and myosin that cover the muscle fibres Muscle spindle sensors (muscle spindle) in their role when before the muscle stretch and input by sensory and connected to the fast muscle stretch to move is called "stretch reflex" (Adhi et al., 2017).

So plyometric training is one of the exercises suitable for sports that require explosive movements, namely movements that contain elements of speed and strength, for example, volleyball sports that require explosive limb muscles. Plyometric movements are designed to move the hips, legs, and special muscle movements influenced by bounding, hopping, jumping, leaping, and skipping. As in the model and form of sports training, plyometric

training also has the goal of helping athletes develop the explosive power needed in almost all sports (Hidayat et al., 2018). Plyometric exercises can be done with a tool in the form of a box jump. A box jump is a jump up and forward, landing with both feet on the box. This exercise requires several boxes, benches, or 12–24-inch-high stages. In addition to its simple movements, its implementation also emphasises using high speed, large and strong explosive power, and shortening the touch time between the soles of the feet and the floor, bench, or stage. So it is suspected that there is an effect of box jump training on leg muscle explosiveness. The box height used in this exercise is 16 inches (Pratama & Erawan, 2019).

In volleyball, leg muscle explosiveness (power) is needed, especially when smashing, blocking, jumping, serving, or moving. Therefore, a player must have good explosive power in a volleyball game. This, of course, will affect the athlete's achievements.

MATERIALS AND METHODS

The research method used in this research is descriptive-quantitative with a pure experimental method, or a true experiment. Because the participants or population is at most 100 people, the sample of this study is volleyball players from SMA Negeri and Sumberejo, totaling 30 people. This research has been carried out at SMA Negeri 1 Sumberejo, and research activities were carried out from October 2, 2022, to November 23, 2022.

The design or pattern used in this study is a pre-test post-test group design, with the understanding that "pre-test post-test group design" is an experiment that uses two experimental groups. The determination of experimental group 1 and experimental group 2 is determined randomly. Both groups are given an initial test or pre-test to measure and ensure the initial condition of each group (Sugiyono, 2015). The next step is that both classes are given treatment; experimental group 1 is given treatment with plyometric box jump training, while experimental group 2 is given treatment with plyometric hurdle jumping training. After treatment, both groups were given a post-test (the final test) to find out the study results.

Group division is based on the results of the initial test of leg muscle explosive power; the first step is to conduct an initial test. Then the subjects with equal achievements are paired into the box jump plyometric exercise group and the hurdle hopping plyometric exercise group. Thus, the two groups had the same ability before treatment. If, in the post-test, there is a difference, then this is due to the effect of the treatment given. The instrument used in this study to measure the increase in leg muscle explosive power in the SMA Negeri 1 Sumberejo volleyball team is the vertical jump test. The data to be collected in this study are pretest and post-test vertical jump data to measure the increase in leg muscle explosiveness before the sample is given treatment and post-test data after treatment. The treatment was carried out for 16 meetings, with a frequency of 3 times a week, namely Tuesday, Thursday, and Saturday afternoon, located at the SMA Negeri 1 Sumberejo field—data analysis using prerequisite tests and independent sample t-tests.

Data analysis is carried out with prerequisite test analysis, namely the normality test (Kolmogorov-Smirnov test) and the variance homogeneity test (with Levene's test). The normality test aims to determine whether the data used in the study comes from a normally distributed sample or not. The homogeneity test aims to determine whether each group's variance is homogeneous. Quantitative research was conducted using a two-way factorial analysis technique (ANOVA) at a significance level of $\alpha = 0.05$ to test the comparative hypothesis of sample means.

RESULTS AND DISCUSSION

Initial test data collection and descriptive statistical results of the initial test before being given the treatment of box jump and hurdle jump training for the volleyball team of SMA Negeri 1 Sumberejo are presented in Table 1 as follows:

Table 1. Descriptive Statistics of Initial Test

Statistik	Box Jump	Hurdle Hopping
N	15	15
Average	56.26	56.33
Std Deviation	9.44	9.97
Sigma	844	845

From the data above, the average value of box jump training is 56.26 and hurdle hopping is 56.33; the standard deviation value of box jump is 9.44 and hurdle hopping is 9.97; and the sum or sigma value of box jump is 844 and hurdle hopping is 845.

Table 2. Descriptive Statistics of the Final Test

Statistik	Box Jump	Hurdle Hopping
N	15	15
Average	64.26	66.40
Std Deviation	9.16	8.37
Sigma	964	996

From the results of Table 2 above, it can be seen that the average value of box jump training is 64.26 and hurdle hopping is 66.40; the standard deviation value of box jump is 9.16 and hurdle hopping is 8.37; and the sum or sigma value of box jump is 964 and hurdle hopping is 996.

Table 3. Normality Test Results

Variable	L calculate		L table	Description
Box Jump	0.114	<	0.234	Normal
Hurdle Hopping	0.086	<	0.227	Normal

From the table above, it shows that the significance value of Ltabel is smaller than L count, so the data is normally distributed.

Table 4. Uji Homogenitas

No	Variable	F alculate		F table	Conclusion
1	Box Jump	0.941	<	2.54	Homogeny
2	Hurdle Hopping	0.705	<	2.54	Homogeny

Based on the table above, it is known that the value of F htiung is smaller than the value of F table, so the author can conclude that the data is homogeneous or the same.

Table 5. Hypothesis Test of the Effect of Box Jump Training

Uji T	T calculate	T table	Description
X1.Y	10.96	1.753	Significant

Based on the results of the analysis above, the effect of box jump training is obtained with a t value of 10.96> 1.753 from the t table, so it can be concluded that the effect of box jump training is not significant.

Table 6. Hypothesis Test of the Effect of Hurdle Hopping Exercise

Uji T	T calculate	T table	description
X2.Y	21.13	1.753	Signifikan

Based on the results of the analysis above, the effect of hurdle hopping training is obtained with a t value of 21.13> 1.753 from the t table, it can be concluded that the effect of hurdle hopping training has a significant effect, so the hypothesis is accepted.

Tabel 7. Differences in Effects of Box Jump and Hurdle Hopping

T test	T calculate	T table	Description
Differences in the effects of Box Jump and Hurdle Hopping	0.703	1.753	No Significant

Based on the results of the analysis in the table above, where the t value is 0.703 < T table 1.75, it is concluded that there is no difference in the effect of box jump and hurdle jumping exercises on leg muscle explosiveness in the volleyball team of SMA Negeri 1 Sumberejo.

The effect of plyometric box jump and plyometric hurdle hopping exercises on the explosive power of leg muscles in the volleyball team SMA Negeri 1 Sumberejo researchers oriented to the results of the study found there was a significant effect of plyometric box jump and plyometric hurdle hopping exercises on the explosive power of leg muscles in the volleyball team SMA Negeri 1 Sumberejo. In simple terms, training can be formulated as all the power and effort to improve overall physical condition through a systematic and repetitive process with increasing amounts of training load, time, or intensity (Bakar & Nur, 2020). Someone trains because it is a form of effort to achieve a goal. "Training is a systematic process of practicing or working that is done repeatedly by increasing the amount of exercise or work (Abrian & Nasuka, 2021)". Research conducted (Gusfirnando et al., 2015) found that box jumping is a special exercise to increase leg muscle power. This exercise is part of the depth jump exercise. The muscles developed in box jump training include thigh flexion, knee extension, adduction, and abduction involving the gluteus medius and minimus muscles, adductor longus, brevis, magnus, minimus, and halucis. The researcher added that a box jump is an upward and forward jump, landing with both feet on a box. This exercise requires several boxes, benches, or stages that are between 12 and 24 inches high". In addition to its simple movements, its implementation also emphasises using high speed, large and strong explosive power, and shortening the touch time between the soles of the feet and the floor, bench, or stage. So it is suspected that there is an effect of box jump training on leg muscle explosiveness. The height of the box used in this exercise is 16 inches. As stated above, increasing the explosive power of leg muscles can be done by training hurdle hopping.

CONCLUSION

There is a significant effect of plyometric box jump training on leg muscle explosive power (t count -7.63 > t table) on the volleyball team of SMA Negeri 1 Sumberejo. There is a significant effect of plyometric hurdle hopping training on leg muscle explosiveness (t count -10.21 > t table) on the volleyball team SMA Negeri 1 Sumberejo. There is no difference between plyometric box jump training and plyometric hurdle jumping training significantly on leg muscle explosiveness (t count 0.703 < t table) in volleyball team SMA Negeri 1 Sumberejo.

CONFLICT OF INTEREST

Author No conflict of interest to declare.

REFERENCES

Abrian, A. R., & Nasuka. (2021). Pengaruh Latihan One Leg Jump Dan Lateral Jump Over Barrier Terhadap Power Otot Tungkai Kemampuan Smash Bola Voli. *Unnes Journal of Sport Sciences*, *5*(2), 70–75.

Adhi, B. P., Sugiharto, & Soenyoto, T. (2017). Pengaruh Latihan dan kekuatan Otot Tungkai terhadap Power Otot Tungkai. *Journal of Physical Education and Sports*, *6*(1), 7–13.

Apriyanti, E. P., & Wahyudi, A. (2021). Pembinaan Prestasi Cabang Olahraga Bola Voli di Klub DPU Pati Tahun 2020. *Indonesia Journal for Physical Education and Sport*, *2*(4), 119–124.

Arif, Y., & Alexander, X. F. R. (2019). Pengaruh Latihan Plyometric Jump To Box Terhadap Power Otot Tungkai Pemain Bola Voli Pada Tim Putri Penjaskesrek Undana. *Jurnal Segar*, *8*(1), 38–46. https://doi.org/10.21009/segar/0801.05

Bakar, A., & Nur, A. (2020). Pengaruh Latihan Triceps Push Down Terhadap Kemampuan Servis Atas Bola Voli Siswa SMA Negeri 1 Luwuk. *BABASAL Sport Education Journal*, *1*(1), 7–14. https://doi.org/10.32529/bsej.v1i1.532

Bakti Bachtiar, W., & Kastrena, E. (2019). Hubungan Antara Daya Ledak Otot Lengan Dengan Kemampuan Smash Bola Voli Pada Ekstrakurikuler. *Maenpo*, *9*(1), 18. https://doi.org/10.35194/jm.v9i1.904

Gusfirnando, D., Supriyadi, S., & Saichudin, S. (2015). Pengaruh latihan split squat jump dan box jump terhadap peningkatan daya ledak otot tungkai pada ekstrakurikuler bola voli di SMKN 3 Malang. *Jurnal Sport Science*, *5*(1), 7–15.

Hidayat, T., Saichudin, & Kinanti, R. G. (2018). Pengaruh latihan plyometric depth jump dan jump to box terhadap power otot tungkai pada pemain ekstrakurikuler bolavoli smk teknologi nasional malang. *Jurnal Sport Science*, *7*(2), 120–128.

Nugraheni, A. R., Rahayu, S., & Handayani, O. W. K. (2017). Evaluasi Pembinaan Olahraga Prestasi Bola Voli Pantai Puteri Klub Ivojo (Ikatan Voli Ngembalrejo) di Kabupaten Kudus Tahun 2016. *Journal of Physical Education and Sports*, *6*(3), 225–231.

Pratama, M. I., & Erawan, B. (2019). Perbandingan Pengaruh Latihan Squat Jump dan Plyometric Jump to Box terhadap Peningkatan Power Otot Tungkai. *Jurnal Kepelatihan Olahraga*, *11*(2), 77–82. https://doi.org/10.17509/jko-upi.v11i2.20309

Rahmat Ikbar, Saifuddin, B. (2017). Kontribusi tinggi badan dan tinggi lompatan terhadap smash bola voli pemain bola voli klub lavendos vc kecamatan jaya kabupaten aceh jaya tahun 2016. *Jurnal Ilmiah Mahasiswa Pendidikan Jasmani, Kesehatan Dan Rekreasi*, *3*(3), 242–247.

Ramadani, M. M. (2017). Evaluasi Profil Kondisi Fisik Atlet Bola Voli. *Jurnal Kesehatan Dan Olahraga*, *1*(1), 30–38.

Rudiana, R. D. P., Sahudi, U., Budiman, I. A., & Gustina, M. (2021). Pengaruh Media Papan Kayu Terhadap Keterampilan Passing Bawah Permainan Bola Voli Pada Siswa Smp. *Journal Respecs*, *3*(1), 67. https://doi.org/10.31949/jr.v3i1.2787

Solehudin, D. (2021). Pengaruh Latihan Skipping Terhadap Hasil Loncatan Siswa Putra Pada Peserta Ekstrakurikuler Permainan Bola Voli. *Jurnal Fakultas Keguruan & Ilmu Pendidikan*, *2*(1), 2013–2015.

Sugiyono. (2015). Metode Penelitian Pendidikan. Bandung. *Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif, Dan R&D)*, 308.

Suhairi, M., & Arifin, Z. (2022). Pengembangan Alat Drill Smash Bola Voli Berbasis Reaksi Menggunakan Android. *MULTILATERAL: Jurnal Pendidikan Jasmani Dan Olahraga*, *21*(1), 71–86.