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# PRE-SERVICE TEACHER OF PJOK: THE EFFECT OF BOX SKIP TRAINING ON LEG MUSCLE POWER

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**ABSTRACT**

This study aims to ascertain the impact of the Box Skip Exercise on the leg muscle power of pre-service teachers at STKIP YPUP Makassar. This study employs an experimental design, specifically a quasi-experimental design. In this study, the population and sample were the pre-service teachers of STKIP YPUP Makassar, with a sample size of 30 people divided into two treatment groups and a control group. We used the t-test to test the research data. The research data that was tested with the t-test shows that the treatment group's data has a calculated T value that is higher than the T table with a value of 9.291>1.753. The significance value of 0.00 falls below 0.05, indicating that box skip exercise has a significant impact on the leg muscle power of physical education pre-service teachers. In contrast, the data from the control group revealed a calculated T value of 3.674, which exceeded the T table by 1.753. Additionally, the significance value of 0.00 was less than 0.05, indicating that the treatment group had a greater influence than the control group. Based on the above data, we can conclude that the treatment group exerted a greater influence than the control group in enhancing the leg muscle power of physical education pre-service teachers at STKIP YPUP Makassar.



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## 1. INTRODUCTION

Training is an activity that aims to improve a person's talents, skills, and physical and emotional conditions in sports (Demchenko et al., 2021). The training method is a scientific method carried out in a programmed manner to improve an athlete's talent, technique, and physical condition depending on the sport being played. Sports require athletes to meet certain physical condition requirements, and the athlete's participation in the sport determines how to meet these requirements (Jagim et al., 2021). The ten components of physical conditioning include cardiorespiratory endurance, muscular endurance, muscle strength, flexibility, body composition, speed, agility, balance, reaction speed, and coordination.

Strength is the ability to use muscles and absorb loads during work (Suchomel et al., 2021). However, the body's skeletal muscles can also contract or exert maximum tension to absorb loads during an activity. "Strength," also known as "power," refers to the force of muscle contraction that occurs during a maximal effort. A muscle or group of muscles exerts this maximum effort to overcome resistance. Muscle power is a crucial factor in physical activity because it acts as a driving force and prevents injury (Koźlenia et al., 2022; Zemková, 2022). In addition, strength plays an important role in other components of physical performance, such as agility and speed. This is the main factor influencing the creation of optimal performance.

Strength is also referred to as explosive power. This strength includes the intensity and speed of explosive dynamic muscle contractions that require maximum muscle effort in the shortest time (Kabacinski et al., 2022). Leg muscle explosive power is defined as the ability of human muscles to exert maximum force in a very short time. Athletes with outstanding explosive power can achieve the desired results.

Developing and improving performance is no different from improving performance in other sports. This means that the emphasis is always on implementing conditioning training, including box skip training. Among other things, it is the explosive power of the leg muscles that supports athlete performance. Coaching that is regular, directed, systematic, and supported by adequate facilities and infrastructure is necessary to achieve the desired results (Sugiyono, 2021; Guidotti et al., 2023). Planned, structured, and repetitive physical activity is known as exercise, to improve or maintain physical fitness.

A person must be in excellent physical condition to achieve the desired performance results. Since sports activity training necessitates the strength of leg muscles, particularly jumping, it is crucial to implement a training program that aims to enhance the strength and explosive power of these muscles, and to train systematically (Ramirez-Campillo et al., 2021; Arntz et al., 2022). Plyometric training, such as box skip training, is an effective exercise for increasing the strength and explosive power of leg muscles. Plyometric box skip training is a type of explosive power exercise that aims to increase the explosive power of the leg muscles when jumping (Abi Permana et al., 2022; Novita et al., 2022). The reason is that sport really requires optimal muscle strength (explosive power) in order to perform optimally.

The goal of this type of exercise is to train the leg muscles to increase strength and speed, as well as develop the habit of automating leg movements when stepping or jumping. Box skip training is a type of exercise that aims to increase the strength of the leg muscles used when running and jumping (Barrio et al., 2023). The exercise engages the muscles of the lower leg and thigh, encompassing both the front and back. According to Markovic & Mikulic (2010), lower extremity plyometric training is an important part of the training of almost all athletes and sports, including throwing, running, and long jump. This exercise requires the athlete to build maximum strength in a short time and quickly.

The box skip exercise involves jumping onto a box or block and then jumping forward with your feet together to return to the starting position (McGinnis, 2013). The

box jump training movement begins by positioning your body on the opposite side of the box or block, receiving a signal that you are ready to jump onto the box or block. When you reach the top, bend your legs slightly, squat lightly, and then jump again quickly. When you land, your feet will naturally touch the ground. Repeating this movement will provide the exercise benefits (Rasti et al., 2020).

Box skip training is a movement that aims to strengthen the leg muscles and train the nervous system, which produces impulses in the form of muscle contractions in a certain pattern so that the muscles produce the strongest contractions in a short time and can produce strong contractions. The box skips plyometric training method is based on the principle that the muscles continuously contract, both when lengthening and when contracting (Goodwin & Jeffreys, 2021). Plyometric training helps develop neuromuscular response, explosive strength, speed, and the ability to generate force in a specific direction. The plyometric training method is a method of developing explosive strength, which is an important part of most athletes' performance. The goal of plyometric training is to achieve local fatigue in the muscles and central nervous system (Elnaggar, 2022; Deng et al., 2023). To achieve the desired results, it is crucial to carefully plan and program the training.

The observed phenomenon shows that many STKIP YPUP Makassar Physical Education and Sports students feel they lack sufficient leg muscle explosive power when participating in PORKAM events. Performances in competitions like volleyball, long jump, basketball, and other sports demonstrate this. Lack of explosive power in the leg muscles can reduce the performance of athletes and competitors in various ways, including jumping, running, and other rapid movements that are important in sports. As a result, participants need to perform exercises that increase the strength and explosive power of their leg muscles in preparation for competition. Planned and targeted training can help competitors overcome a lack of explosive leg muscles, allowing them to perform better in competition and improve overall performance. As a result, the need for training to improve the performance of athletes and PORKAM competition participants is becoming increasingly important. Based on the description above, the author is interested in research to find out the effect of Box Skip training on the leg muscle power of physical education and sports students.

## 2. METHOD

This type of research is an experiment with a quasi-experimental design. Experimental research aims to investigate possible cause-and-effect relationships by subjecting one or more experimental groups to one or more experimental groups (Thyer, 2012; Rogers & Revesz, 2019). Comparing one or more experimental groups that received treatment with a comparison group that did not receive therapy is the way to discover the results. We conducted this research at the STKIP YPUP Makassar campus, using a sample of 30 physical education and sports students from the Class of 2023. We will divide the sample of 30 people into two groups: the treatment group and the control group. Subject matching ordinal pairing, which pairs subjects with identical or nearly

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identical results from the initial test, automatically creates two groups: the treatment group and the control group, both with the same ability level. balanced.

Researchers collected data using a pretest, a test they administered at the first meeting to determine each subject's initial leg muscle power capabilities. The purpose of this was to detect any variations in the results following treatment or treatment over a span of 16 sessions. Participants perform the vertical jump test by standing under a wall and measuring their initial height. Next, the testee jumps to achieve the highest measurement achieved in a sideways position on the wall. The testee performs the jump three times, and the best jump from these three attempts determines the score.

After completing the initial test, we divide the 30 selected samples into two groups and administer the treatment using the original pairing technique for each group. The box skip training group employed exercises designed using the box skip plyometric training tool. We conducted this exercise over 16 sessions at a frequency of 3-4 times per week, and in this study, we executed the exercises in accordance with the training plan. This aligns with the perspective of Kurniawan & Sifaq (2018), who advocated for 16 treatment sessions at a frequency of 3-4 times per week. Unlike the treatment group, the control group only engaged in general training during daily field class meetings, which included activities like warming up, running around the field, and strengthening basic techniques specific to each Physical Education student's sport.

In this research, we conducted the final test, a vertical jump test, identical to the initial test, to determine the outcomes of each test participant in both the treatment and control groups. During the final 16-meeting session, we conducted this test. We collected and analyzed all data from the pretest and posttest using SPSS 24, drawing conclusions from the obtained research results. Figure 1 presents an example of the vertical jump test, which is the central theme of this research.

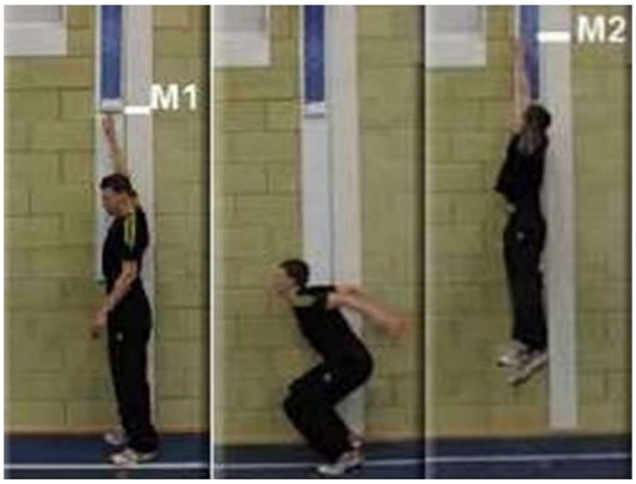


**Figure 1**. Vertical Jump Test

## 3. RESULTS AND DISCUSSION

### Results

We obtained the results of this research through multiple meetings, which included observation, initial tests, and the final test, where we administered box skip exercises to

the treatment group and left the control group without treatment. The aim is to find reliability and compare the results of the pretest and posttest, thus obtaining the following data.

**Table 1**. Pretest Results of Treatment Group and Control Group

| Descriptive Statistics | | |
|---|---|---|
| **Variabel** | ***Pretest* (Treatment Group)** | ***Pretest* (Control Group)** |
| N | 15 | 15 |
| Range | 23 | 24 |
| Minimum | 41 | 38 |
| Maximum | 64 | 62 |
| Sum | 810 | 817 |
| Mean | 54.00 | 54.47 |
| Std. Deviation | 6.492 | 6.081 |
| Variance | 42.143 | 36.981 |

The descriptive analysis showed that among the 15 samples studied for the treatment group pretest, the lowest value was 41 and the highest was 64. The average value was 54.00, and the total number of points was 810. The standard deviation was 6,492, and the range was 42,143. Meanwhile, the control group pretest data from the 15 samples studied showed a minimum value of 38, a maximum value of 62, an average of 54.47, and a total of 817, with a standard deviation of 6,081, a variance of 36,981, and a range of 24. Below are presented in Table 2 the posttest results of the treatment group and control group.

**Table 2**. Posttest Results of Treatment Group and Control Group

| Descriptive Statistics | | |
|---|---|---|
| **Variabel** | ***Posttest* (Treatment Group)** | ***Posttest* (Control Group)** |
| N | 15 | 15 |
| Range | 22 | 23 |
| Minimum | 44 | 39 |
| Maximum | 66 | 62 |
| Sum | 854 | 826 |
| Mean | 56.93 | 55.07 |
| Std. Deviation | 6.123 | 5.958 |
| Variance | 37.495 | 35.495 |

The descriptive analysis in Table 2 revealed that the treatment group posttest data from the 15 studied samples ranged from a minimum of 44 to a maximum of 66, with an average of 56.93. The total was 854, with a standard deviation of 6,123, and a variance of 37,495, with a range of 22. Meanwhile, the control group posttest data from the 15 samples studied showed a minimum value of 39, a maximum value of 62, an average of 55.07, and a total of 826, with a standard deviation of 5,958, a variance of 35,495, and a range of 23.

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***Normality test***

**Table 3**. Pretest normality test for treatment group and control group

| Tests of Normality | | | | |
|---|---|---|---|---|
| **Group** | **Shapiro-Wilk** | | | **Information** |
| | **Statistic** | **df** | **Sig.** | |
| *Pretest* (Treatment) | 0.915 | 15 | 0.161 | Normal |
| *Pretest* (Control) | 0.899 | 15 | 0.092 | Normal |

In this study, the test results in the table above, which included one of the prerequisite tests for the normality test, revealed a normal distribution of the data. Specifically, the pretest treatment group yielded a statistical value of 0.915 out of the 15 samples tested, with a significance level of 0.161. The 0.161 value exceeds alpha 0.05, indicating a normal distribution of the resulting data. Meanwhile, for the control group pretest, the statistical value was 0.899 out of the 15 samples tested, with a significance of 0.092. The value of 0.092 exceeds alpha 0.05, indicating that the resulting data has a normal distribution.

**Table 4**. Posttest Normality Test for Treatment Group and Control Group

| Tests of Normality | | | | |
|---|---|---|---|---|
| **Group** | **Shapiro-Wilk** | | | **Information** |
| | **Statistic** | **df** | **Sig.** | |
| *Posttest* (Treatment) | 0,943 | 15 | 0,419 | Normal |
| *Posttest* (Control) | 0,896 | 15 | 0,082 | Normal |

The test results in the table above, which included one of the prerequisite tests for the normality test, revealed a normal distribution of the data in this study. Specifically, the posttest for the treatment group yielded a statistical value of 0.943 out of the 15 samples examined, with a significance level of 0.419. The value of 0.419 surpasses alpha 0.05, indicating a normal distribution of the resulting data. Meanwhile, for the control group posttest, the statistical value was 0.896 out of the 15 samples tested, with a significance of 0.082. The value of 0.082 surpasses alpha 0.05, indicating a normal distribution of the resulting data.

***Homogeneity Test***

The homogeneity test yielded results with a significance value greater than 0.05 for both the treatment group and the control group. The mean section displays a value of 0.918 for both the treatment group and the control group. Based on the basis for making this decision, because the significance value in the based on mean section is greater than 0.05, the data held is homogeneous.

***T test***

**Table 5**. Paired Sample Statistical Test for Treatment Group and Control Group

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pair 1 | *Pretest* (Treatment) | 54.00 | 15 | 6.492 | 1.676 |
| | *Posttest* (Treatment) | 56.93 | 15 | 6.123 | 1.581 |
| Pair 2 | *Pretest* (Control) | 54.47 | 15 | 6.081 | 1.570 |
| | *Posttest* (Control) | 55.07 | 15 | 54.00 | 1.538 |

Based on the paired statistical sample test between the treatment group and the control group of Physical Education student athletes at STKIP YPUP Makassar, the results showed that the pretest treatment group had a standard deviation of 6,492, while the posttest treatment group had a standard deviation of 6,123 from the 15 samples that underwent treatment. The mean standard error was 1.676 for the treatment group pretest and 1.581 for the treatment group posttest. The treatment group achieved an average pretest result of 54.00 and a posttest result of 56.93. Meanwhile, for the control group pretest, the resulting standard deviation was 6.081, and for the control group posttest, the resulting standard deviation was 54.00 from 15 samples given treatment, with a mean standard error of 1.570 for the control group pretest and control group posttest of 1.538. The control group's average pretest result was 54.47, while their posttest result was 55.07. These results demonstrate an increase, and the next test will determine the extent of this increase.

**Table 6**. Paired Sample Test for Treatment Group and Control Group

| | **Paired Differences** | |
|---|---|---|
| | ***Pretest* and *Posttest* (Group Treatment)** | ***Pretest and Posttest* (Control Group)** |
| **Mean** | 2.933 | 0.600 |
| **Std. Deviation** | 1.223 | 0.632 |
| **Std. Error Mean** | 0.316 | 0.163 |
| **T** | 9.291 | 3.674 |
| **Df** | 14 | 14 |
| **Sig. (2-tailed)** | 0.000 | 0.000 |

The research explains that the treatment group's pretest and posttest results show a calculated t greater than the t table with a value of 9.291>1.753 and a significance value of 0.000 less than 0.05, indicating a significant influence. On the other hand, the control group's pretest and posttest results show a calculated t greater than the t table, with a value of 3,674>1,753 and a significance value of 0.000 less than 0.05, indicating a significant influence in the group. With the significant influence of the two groups, the researcher looked at the average increase that occurred in the mean column of the table above, so from the mean we could see the difference in the influence of the two groups.

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The treatment group experienced an average increase of 2,933, while the control group experienced an average increase of 0,600. The standard deviation mean error table explains that a maximum increase of 0.316 is possible for the treatment group, while a maximum increase of 0.163 is possible for the control group. This clearly demonstrates the superior performance of the box skip training treatment group compared to the control group without any treatment. The subsequent discussion will delve deeper into the findings of this study.

**Discussion**

After participating in box skip plyometric training for 16 meetings, physical education and sports students at STKIP YPUP Makassar can determine whether their leg muscle power has increased based on the t test analysis. This is because plyometric training trains power, which is a combination of two elements: speed and strength (de Villarreal et al., 2013). Plyometric training executes with precision and strength, ensuring the maximum utilization of energy reserves during contraction and relaxation.

Researchers use a plyometric training model to train their subjects. Plyometrics is one of the most effective training models for increasing muscle explosive power (Wang, 2023). Training targets three large muscle groups in the body: the leg and hip muscle groups, the middle muscle groups, and the chest, shoulder, and arm muscle groups, to develop explosive power and reaction speed. The training also resulted in an increase in control of the flexor and extensor muscles of the lower limbs during the preparation phase immediately before the shot. This is due to the necessity of pulling or extending the lower leg must be pulled or extended at the knee joint during preparation. Furthermore, the muscles in the upper front leg serve an additional function, which is to ensure smooth execution of the extensor and flexor movements.

Box skip Plyometric exercises include rapid and strong movements with eccentric contractions (eccentric concentration) followed by concentric contractions (Behrens et al., 2016). If you look at the type of contraction, isokinetic contraction is a combination of eccentric and concentric contraction types. The combination of these two types of contractions is plyometric. The characteristics of plyometric training are almost the same as isokinetic training, that is, when the muscle is against an object, whether in a lengthened or shortened state, it always contracts, and there is no relaxation.

Plyometric box skip training is an effective exercise for enhancing jumping ability, as it combines strength and speed, two key components of power. Based on statistical tests with an alpha of 5%, the results indicated that box skip training, or the treatment group, had a greater influence on increasing leg muscle power in Physical Education students at STKIP YPUP Makassar than in the control group. According to the conducted tests, the treatment group experienced an average increase of 2,933, while the control group experienced an average increase of 0,600. The treatment group experienced a maximum increase of 0.316 in the standard deviation value of the mean error, while the control group experienced a maximum increase of 0.163. This clearly demonstrates that the treatment group for box skip training outperformed the control group without any treatment. These results are shown by t count > t table; thus, this research proves that the plyometric box skip exercise is more effective than other

ordinary exercises. This exercise requires the muscles to work against a repetitive, continuous load. continuously quickly. The plyometric training load is based on your body weight (internal load). Exercise box skip involves leaping onto a box. Jumping movements done quickly and explosively can increase muscle strength as well as speed of muscle movement.

According to Bompa & Haff (2009), regular training for 6–8 weeks will yield specific results as the body adjusts to the training. Furthermore, Nala Furthermore, Ketelhut & Ketelhut (2020) state that systematically, progressively, and repeatedly provided training will improve the body's organ systems, resulting in optimal physical appearance. Training carried out with a frequency of 3-4 times a week will produce significant improvements. Applying physical training regularly, in a measured manner, with sufficient amounts and time, can lead to changes in energy production and physical appearance.

Previous research by Putra & Irianto (2019) confirms the impact of plyometric box skip training on leg muscle power, demonstrating a significant influence on both initial and final test results.

## 4. CONCLUSION

The research concludes, after data analysis and discussion, that box skip training significantly impacts the leg-muscle power of physical education pre-service teachers at STKIP YPUP Makassar. This conclusion is based on the analysis of the treatment group, which yielded a mean value of 2.933, a standard deviation value of 1.223, a standard error mean value of 0.316, and a calculated T value that exceeds the T table by 9.291>1.753, with a significance value of 0.00, which is less than 0.05. Meanwhile, the control group's analysis yielded a mean value of 0.600, a standard deviation value of 0.632, a standard error mean value of 0.163, and a calculated T value greater than the T table with a value of 3.674>1.753 and a significance value of 0.00, which was less than 0.05.

As a suggestion, the pre-service teacher needs to do exercises that increase the strength and explosive power of their leg muscles in preparation for competition. Therefore, there is a need for training to support increased performance by athletes and competition participants. In addition, the research results can serve as a guide for larger-scale research.

## REFERENCES

Abi Permana, D., Kusnanik, N. W., Nurhasan, N., & Raharjo, S. (2022). A six-week plyometric training program improves explosive power and agility in professional athletes of east java. *Physical Education Theory and Methodology*, *22*(4), 510-515.

Arntz, F., Mkaouer, B., Markov, A., Schoenfeld, B. J., Moran, J., Ramirez-Campillo, R., ... & Chaabene, H. (2022). Effect of plyometric jump training on skeletal muscle hypertrophy in healthy individuals: a systematic review with multilevel meta-analysis. *Frontiers in physiology*, *13*, 888464.

Barrio, E. D., Thapa, R. K., Villanueva-Flores, F., Garcia-Atutxa, I., Santibañez-Gutierrez, A., Fernández-Landa, J., & Ramirez-Campillo, R. (2023). Plyometric jump training exercise optimization for maximizing human performance: A systematic scoping

review and identification of gaps in the existing literature. *Sports*, *11*(8), 150.

Behrens, M., Mau-Moeller, A., Mueller, K., Heise, S., Gube, M., Beuster, N., ... & Bruhn, S. (2016). Plyometric training improves voluntary activation and strength during isometric, concentric and eccentric contractions. *Journal of science and medicine in sport*, *19*(2), 170-176.

Bompa, T. O., & Harf, G. G. (2009). Periodization training for sports: theory and methodelogy of training.

Demchenko, I., Maksymchuk, B., Bilan, V., Maksymchuk, I., & Kalynovska, I. (2021). Training future physical education teachers for professional activities under the conditions of inclusive education. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, *12*(3), 191-213.

Deng, N., Soh, K. G., Abdullah, B., Huang, D., Xiao, W., & Liu, H. (2023). Effects of plyometric training on technical skill performance among athletes: A systematic review and meta-analysis. *Plos one*, *18*(7), e0288340.

de Villarreal, E. S., Requena, B., Izquierdo, M., & Gonzalez-Badillo, J. J. (2013). Enhancing sprint and strength performance: combined versus maximal power, traditional heavy-resistance and plyometric training. *Journal of science and medicine in sport*, *16*(2), 146-150.

Elnaggar, R. K. (2022). Effects of plyometric exercises on muscle-activation strategies and response-capacity to balance threats in children with hemiplegic cerebral palsy. *Physiotherapy Theory and Practice*, *38*(9), 1165-1173.

Goodwin, J. E., & Jeffreys, I. (2021). Plyometric Training. *Strength and Conditioning for Sports*.

Guidotti, F., Demarie, S., Ciaccioni, S., & Capranica, L. (2023). Knowledge, competencies, and skills for a sustainable sport management growth: a systematic review. *Sustainability*, *15*(9), 7061.

Jagim, A. R., Fields, J. B., Magee, M., Kerksick, C., Luedke, J., Erickson, J., & Jones, M. T. (2021). The influence of sport nutrition knowledge on body composition and perceptions of dietary requirements in collegiate athletes. *Nutrients*, *13*(7), 2239.

Kabacinski, J., Szozda, P. M., Mackala, K., Murawa, M., Rzepnicka, A., Szewczyk, P., & Dworak, L. B. (2022). Relationship between isokinetic knee strength and speed, agility, and explosive power in elite soccer players. *International journal of environmental research and public health*, *19*(2), 671.

Ketelhut, S., & Ketelhut, R. G. (2020). Type of exercise training and training methods. *Physical Exercise for Human Health*, 25-43.

Koźlenia, D., Struzik, A., & Domaradzki, J. (2022). Force, power, and morphology asymmetries as injury risk factors in physically active men and women. *Symmetry*, *14*(4), 787.

Markovic, G., & Mikulic, P. (2010). Neuro-musculoskeletal and performance adaptations to lower-extremity plyometric training. *Sports medicine*, *40*, 859-895.

McGinnis, P. M. (2013). *Biomechanics of sport and exercise*. Human Kinetics.

Novita, N., Harahap, P. O., Sagala, R. S., & Pasaribu, A. M. N. (2022). Effect of plyometric exercises on limb muscle power in volleyball players. *Jurnal SPORTIF: Jurnal Penelitian Pembelajaran*, *8*(1), 131-144.

Putra, D. P., & Irianto, S. (2019). Pengaruh Latihan Pliometrik Terhadap Peningkatan Power Tungkai Dan Jauhnya Long Pass Pada Siswa Ku 14 Tahun Ssb Kridaning Karso Ksatrio (Kkk) Klajuran The Effect Of Pliometric Exercise On Improving Power Of The Single And Long Pass In Students Of Ku 14 Years Ssb Kridaning Karso Ksatrio (Kkk) Klajuran. *Pend. Kepelatihan Olahraga-S1*, *8*(5).

Ramirez-Campillo, R., Garcia-Pinillos, F., Chaabene, H., Moran, J., Behm, D. G., &

Granacher, U. (2021). Effects of plyometric jump training on electromyographic activity and its relationship to strength and jump performance in healthy trained and untrained populations: a systematic review of randomized controlled trials. *The Journal of Strength & Conditioning Research*, *35*(7), 2053-2065.

Rasti, E., Rojhani-Shirazi, Z., Ebrahimi, N., & Sobhan, M. R. (2020). Effects of whole-body vibration with exercise therapy versus exercise therapy alone on flexibility, vertical jump height, agility and pain in athletes with patellofemoral pain: a randomized clinical trial. *BMC Musculoskeletal Disorders*, *21*, 1-9.

Rogers, J., & Revesz, A. (2019). Experimental and quasi-experimental designs. In *The Routledge handbook of research methods in applied linguistics* (pp. 133-143). Routledge.

Suchomel, T. J., Giordanelli, M. D., Geiser, C. F., & Kipp, K. (2021). Comparison of joint work during load absorption between weightlifting derivatives. *The Journal of Strength & Conditioning Research*, *35*, S127-S135.

Sugiyono, S. (2021). The evaluation of facilities and infrastructure standards achievement of vocational high school in the Special Region of Yogyakarta. *Jurnal Penelitian Dan Evaluasi Pendidikan*, *25*(2), 207-217.

Thyer, B. A. (2012). *Quasi-experimental research designs*. Oxford University Press.

Wang, X., Lv, C., Qin, X., Ji, S., & Dong, D. (2023). Effectiveness of plyometric training vs. complex training on the explosive power of lower limbs: A Systematic review. *Frontiers in physiology*, *13*, 1061110.

Zemková, E. (2022). Strength and power-related measures in assessing core muscle performance in sport and rehabilitation. *Frontiers in Physiology*, *13*, 861582.