

# The Effect of Lower Body Plyometric Exercise on The Power of Soccer Athletes Ages 12-16

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**Abstract:** This study aims to (1) Determine the effect of lower body plyometric training on the power of soccer athletes aged 12-16 years, (2) Know the effect of traditional physical training on the power of soccer athletes aged 12-16 years, (3) Know the difference between lower body plyometric exercise with traditional physical exercise against power soccer athletes aged 12-16 years. The subjects of the study amounted to 60 Soccer School (SSB) athletes aged 12-16 years. The samples were divided into 2 groups, namely group 1 totaling 30 people and group 2 totaling 30 people and given different treatment for 8 weeks. Group 1 was given lower body plyometric exercises and group 2 continued to do traditional physical exercises. This research instrument used Multiple Five Bounds Test (MB5). The data were analyzed with a paired t-test to determine the difference between before and after training in both groups and a t-independent test to test the difference in power in both groups. The results of this study show (1) there is an effect of lower body plyometric training on the power of soccer athletes aged 12-16 years with a significance value of  $0.00 < 0.05$ , (2) there is an effect of traditional power training on the power of soccer aged 12-16 years with a significance value of  $0.00 < 0.05$ , (3) there is a difference between Lower body plyometric training with traditional physical training on power soccer athletes aged 12-16 years with a significance value of  $0.00 < 0.05$ . It can be concluded that lower body plyometric exercises are better than traditional physical exercises to increase the power of soccer athletes aged 12-16 years.

**Keywords:** plyometric, power, soccer

## INTRODUCTION

According to Ferley et al., (2020) Soccer is a sport characterized by high demands for continuous, intense, and intermittent training during a 90-minute game, athletes cover a distance of up to 10 km, perform more than 1,000 activities in one match such as acceleration, deceleration, jumping, changing direction, and so on. According to Campillo, et al., (2015) the physical demands of soccer players are not only for adult soccer athletes, but also apply to youth soccer athletes. according to Michailidis (2015) One of the very important physical demands in soccer is power. According to Ince, et al., (2018) the physical component for soccer athletes is lower extremity power. According to Ramirez-Campillo et al., (2020). Lower-limb muscle power is related to team positioning in competitive soccer leagues. According to Rubley et al., (2011) Limb

muscle power is very important and is a major concern by a soccer physical trainer. According to Negra et al., (2017) Physical exercise that is suitable for increasing leg muscle power of adolescent soccer athletes is plyometric exercise.

According to Bedoya et.al., (2015) Lower body plyometric exercise is a very popular physical exercise where the form of exercise is by jumping using body weight as a weight and utilizing the action of the stretch-shortening cycle (SSC) on the muscles. According to Haff & Travis (2016) Types of lower body plyometric drills include jumps in place, standing jumps, multiple hops and jumps, bounds, box drills, and depth jumps. According to Kobal (2017) Lower body plyometric model physical exercise is highly recommended in youth soccer because it is very practical, safe and efficient. According to Raouf et al., (2016) many published scientific studies recommend plyometric exercises can increase leg muscle power. Thus power in soccer is very important because leg muscle power is very useful for running at maximum speed, kicking the ball by giving bait to friends (passing), or jumping or jumping and kicking towards the target (shooting).

From the observations of researchers in Sekolah Sepak Bola (SSB) found the problem that coaches and athletes do not have guidelines for implementing plyometric exercises. So that the plyometric exercises applied by the trainer are carried out haphazardly and are not in accordance with the principles of exercise. According to Read et al., (2017) If left unchecked, it results in plyometric training for adolescent soccer athletes being ineffective, very difficult, boring, prone to injury and hindering athletes from reaching the peak of their achievements. This is the basis for researchers to make plyometric exercises of the lower body of soccer aged 12-16 years. As far as researchers know, no studies have looked at lower body plyometric exercises for soccer athletes aged 12-16 years. Researchers feel interested in helping the physical condition of soccer training by compiling a lower body plyometric exercise program in order to help increase the muscle power of the lower limbs of soccer athletes aged 12-16 years so that in the future it can produce reliable Indonesian soccer athletes who are able to compete in the international arena.

## **METHOD**

This research is an experimental-research with a research design using pretest – posttest group design. The study was carried out at the Bintaro Black Crow Field with an exercise program for 8 weeks with a frequency of exercise 3 times a week, namely on Tuesday, Thursday and Sunday. The population in this study was SSB Gagak Muda Jakarta athletes aged 12-16 years. The subjects of the study were 60 soccer athletes aged 12-16 years divided into two treatment groups of 30 subjects each, namely

treatment 1 (lower body plyometric exercise combined with passing, dribbling, shooting and heading) and treatment 2 (traditional physical training).

The implementation of the study began with collecting data by conducting a pretest by measuring leg muscle power using a multiple five bounds test research instrument. After the pretest for group one was given treatment in the form of a lower body plyometric exercise program combined with passing,

dribbling, shooting and heading. As for group two was not given a plyometric exercise program or continued to do traditional physical exercise. Exercise is carried out for 8 weeks and the frequency of exercise is 3 times a week.

Posttest is done by measuring the power of the lower leg muscles using a multiple five bounds test research instrument. According to Michailidis et al., (2013) the Multiple Five Bounds Test (MB5) not only reflects power development but also coordination and offers better specificity to soccer players compared to the Vertical Jump test. According to Rami´Rez-Campillo et al., (2015) Multiple Five Bounds Test (MB5) starts from a standing position. The subjects performed a set of 5 forward jumps with alternate left and right foot contacts to cover the farthest distance. The distance of MB5 was measured to the nearest 0.5 cm using a 20 m fiberglass tape measure.

**Table 1.** The plyometric exercises of the lower body of the soccer

Number	Lower Body Plyometric Exercises	Set	Reps	Number of jumps
1	Two-Foot Ankle Hop combination Passing	3	8	24
2	Single-Leg Ankle Hop combination Passing	3	8	24
3	Squat Jump combination Passing	3	8	24
4	Jump and Reach combination Passing	3	8	24
5	Double-Leg Tuck Jump combination Passing	3	8	24
6	Split Squat Jump combination Dribbling	3	8	24
7	Cycled Split Squat Jump combination Dribbling	3	8	24
8	Single-Leg Tuck Jump combination Dribbling	3	8	24
9	Pike Jump Combination Dribbling	3	8	24
10	Double-Leg Vertical Jump combination Dribbling	3	8	24
11	Single-Leg Vertical Jump Shooting combination	3	8	24
12	Jump Over Barrier Shooting combination	3	8	24
13	Standing Long Jump Shooting combination	3	8	24
14	Double-Leg Hop Shooting combination	3	8	24
15	Double-Leg Zigzag Hop Shooting combination	3	8	24
16	Single-Leg Hop Heading combination	3	8	24
17	Front Barrier Hop Heading combination	3	8	24
18	Lateral Barrier Hop Heading combination	3	8	24
19	4-Hurdle Drill Heading combination	3	8	24
20	Skip Heading combination	3	8	24

Data analysis techniques perform statistical descriptive analysis, paired t-test and Independent T- test where all data processing is done with the help of a computer using the SPSS 21 application for windows.

## RESULTS

Description of Pretest data (initial test) using research instruments, namely multiple five bound tests from group 1 and group 2. After implementation, the following results are obtained:

**Table 2.** Descriptive Statistics Pretest and Posttest

	N	Minimum	Maximum	Mean	Std. Deviation
Pre Test Group 1	30	6.85	8.75	7.8630	.53324
Post Test Group 1	30	9.85	12.15	11.2373	.64604
Pre Test Group 2	30	6.85	8.75	7.8630	.53324
Post Test Group 2	30	7.25	11.15	9.0833	.85894
Valid N (listwise)	30				

In group 1 before being given lower body plyometric exercise treatment, an average value of 7.8630 was obtained and after being given a lower body plyometric exercise model, the average value of group 1 was 11.2373. As for the pre-test group 2 obtained an average score of 7.8630 and posttest group 2 obtained a value of 9.0833. The descriptive results of the mean value showed an increase in the average leg muscle power test using multiple five bounds test research instruments from both groups. So, it can be concluded that the leg muscle power of soccer athletes aged 12-16 years for group 1 has increased higher than group 2.

### Test Results of Paired Sample T-Test between PreTest and Post Test for Group 1

**Table 3.** Results of Paired Samples Correlation Pre test and Post test Group 1

	N	Correlation	Sig.
Pair 1 PreTest Group 1 & Post Test Group 1	30	.679	.000

From the table of results output table above that the correlation coefficient of the test and measurement of leg muscle power using multiple 5 bounds test research instruments before and after being given the lower body plyometric exercise obtained a p-value of  $0.000 < 0.05$  so the conclusion is that there is a significant relationship between the pre-test and post-test group 1.

### Test Results of Paired Sample T-Test between Pre Test and Post Test Group 2

**Table 4.** Results of Paired Samples Correlation Pre test and Post test Group 2

	N	Correlation	Sig.
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Pair 1	PreTest Group 2 & Post Test Group 2	30	.719	.000
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From the table output of the table above, the correlation coefficient of the test and measurement of leg muscle power using the multiple five bounds test research instrument before and after traditional physical exercise obtained a p-value of  $0.000 < 0.05$ , so the conclusion is that there is a significant relationship between the pre-test and post-test group 2.

Test Results Independent Sample T Pos test Group 1 and post test Group 2

**Table 5.** Independent Test Sample T-Test post test group 1 and Post test group 2

M5B Test	Levene's Test for Equality of Variances	t-test for Equality of Means	
	F	df	Sig. (2-tailed)
Equal Variance Assumed	1.505	58	0,000

Based on the results of the data analysis above, a significant value (2-tailed) or p-value of  $0.00 < 0.05$ . Thus the hypothesis proposed is tested by data so that it can be concluded that the results of the leg muscle power test using the multiple five bounds test research instrument there are differences between group 1 and group 2.

**Table 6.** 1N-Gain Score Test

Group		N	Mean	Std. Deviation	Sig.(2-tailed)
N-Gain_Persen	Group 1	30	56.618	.51971	0,000
	Group 2	30	43.325	.65586	

The results of the N-gain test Percent Score of group 1 obtained a value of Mean= 56.618 or equal to 56% is included in the category of moderately effective. Meanwhile, the results of the N-gain test score of group 2 obtained a value of Mean = 43.325 or equal to 43.325% fall into the less effective category. So it can be concluded that the lower body plyometric exercise model to increase leg muscle power of soccer athletes aged 12-16 years is more effective than traditional physical exercise. This corroborates that lower body plyometric exercises combined with passing, dribbling, shooting and heading to increase leg muscle power of soccer athletes aged 12-16 years are very effective to increase the biomotor power component of lower leg muscles.

## DISCUSSION

Lower body plyometric exercises to increase leg muscle power of soccer athletes aged 12-16 years were made by researchers to help improve the physical condition of soccer athletes, especially the power of lower leg muscles of soccer athletes aged 12-16 years. This exercise is made indeed based on the needs of the physical condition of soccer athletes aged 12-16 years. Lower body plyometrics are very suitable for use to increase the power training of the lower leg muscles of soccer athletes. This increase is inseparable from the adaptive response of the muscles involved to cope with the load given in the form of a structured, regular, and measurable program. The exercise program is carried out in a relatively long time, which is 8 weeks. This is in line with research from (Slimani et al., 2016) This review also shows that short PT (<8 weeks) has the potential to enhance a wide range of athletic performance (i.e. jumping, sprinting and agility) in children and youth amateur players. The form of lower body plyometric exercise treatment is combined with basic passing, dribbling, shooting and heading techniques. The purpose of this training combination is in line with what Thomas et al., (2009) revealed that this plyometric exercise combination aims so that athletes do not lose touch of the ball when doing physical exercise.

In lower body plyometric exercises, the muscles that are heavily involved are the muscles in the lower extremities, both large and small muscles when observed physiologically. Movement in lower body plyometric exercises is very beneficial for developing the strength of the muscles of the gluteals, hamstrings, quadriceps, and gastrocnemius. According to Read et al., (2019) The more flexible the muscles and the less time the feet are in contact with the ground will be more effective at generating reactive forces from the neuromuscular system. When performing plyometric exercise movements, the lower body muscles of the lower limbs are pulled so as to develop elastic strength. As revealed by Fischetti et al., (2018) through lower body plyometric exercises, muscle strength will develop optimally so that it will support the increase in muscle power of the lower limbs of soccer athletes.

The plyometric body of the lower body is arranged in a structured, regular, and measurable program so that the exercise is easy to do and in accordance with the ability of the soccer athlete so that the athlete is very happy, becomes more active and enthusiastic so as not to cause boredom when doing plyometric exercises. Lower body plyometric exercises affect the leg muscle power of soccer athletes aged 12-16 years because the power training applied can increase reactive strength that is needed in soccer match situations. Therefore, lower body

plyometric exercises are very important to be applied by soccer coaches when doing physical exercise, especially training the power of the lower leg muscles of their athletes.

## CONCLUSION

Lower body plyometric exercises combined with passing, dribbling, heading, shooting techniques performed for 8 weeks can increase leg muscle power in soccer athletes aged 12-16 years and lower body plyometric exercises are better than traditional physical exercises.

## Conflict of Interest

We have no conflict of interest

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## REFERENCES

- Bedoya, A. A., Miltenberger, M. R., & Lopez, R. M. (2015). Plyometric Training Effects On Athletic Performance In Youth Soccer Athletes: Asystematic Review. *Journal of Strength and Conditioning Research*, 29(8), 2351–2360.
- Ferley, D. D., Scholten, S., & Vukovich, M. D. (2020). Combined Sprint Interval, Plyometric, and Strength Training in Adolescent Soccer Players: Effects on Measures of Speed, Strength, Power, Change of Direction, and Anaerobic Capacity. *Journal of Strength and Conditioning Research*, 34(4), 957– 968. <https://doi.org/10.1519/JSC.0000000000003476>
- Fischetti, F., Vilardi, A., Cataldi, S., & Greco, G. (2018). Effects of plyometric training program on speed and explosive strength of lower limbs in young athletes. *Journal of Physical Education and Sport*, 18(4), 2476–2482. <https://doi.org/10.7752/jpes.2018.04372>
- Haff, G. G., & Travis, T. N. (2016). *Essentials of Strength Training and Conditioning*. In National Strength and Conditioning Association (IV). Human Kinetics.
- Ince, T., & Daglioglu, O. (2018). The effect of the plyometric training program on sportive performance parameters in young soccer players. *Turkish Journal of Sport and Exercise*, 28, 184–190. <https://doi.org/10.15314/tsed.466268>
- Kobal, R., Pereira, L. A., Zanetti, V., & Ramirez-campillo, R. (2017). Effects of Unloaded vs . Loaded Plyometrics on Speed and Power Performance of Elite Young Soccer Players. *Frontiers in Physiology*, 8(September), 1–7. <https://doi.org/10.3389/fphys.2017.00742>
- Michailidis, Y. (2015). Effect of plyometric training on athletic performance in preadolescent soccer players. *Journal of Human Sport and Exercise*, 10(1), 15–23. <https://doi.org/10.14198/jhse.2015.101.02>
- Michailidis, Y., Fatouros, I. G., Primpa, E., Ichailidis, C. H. M., Soukas, D. I. T., Ouroudos, I. O. I. D., Raganidis, D. I. D., Eontsini, D. I. L., Argonis, K. O. M., Erberidou, F. A. N. I. B., &

- Ambas, A. N. K. (2013). Plyometrics' Trainability In Preadolescent Soccer Athletes. *Journal of Strength and Conditioning Research*, 27(1), 38–49.
- Negra, Y., Chaabene, H., Sammoud, S., Bouguezzi, R., Mkaouer, B., Hachana, Y., & Granacher, U. (2017). Effects of plyometric training on components of physical fitness in prepuberal male soccer athletes: The role of surface instability. *Journal of Strength and Conditioning Research*, 31(12), 3295–3304. <https://doi.org/10.1519/JSC.0000000000002262>
- Rami´Rez-Campillo, R., Burgos, C. H., Henri´Quez-Olguin, C., Andrade, D. C., Marti´Nez, C., Lvarez, C. A., Lveda, Mauricio Castro-Sepu´Marques, M. R. C., & Izquierdo, M. (2015). Effect Of Unilateral,Bilateral, And Combined Plyometric Training On Explosive And Endurance Performance Of Young Soccer Players. *Journal of Strength and Conditioning Research*, 29(5), 1317–1328.
- Raouf, H., Granacher, U., Makhlof, I., Behm, D. G., & Chaouachi, A. (2016). Sequencing Effects Of Balance And Plyometric Training On Physical Performance In Youth Soccer Athletes. *Journal of Strength and Conditioning Research*, 30(12), 3278–3289.
- Read, P. J., Oliver, J. L., De Ste Croix, M. B. A., Myer, G. D., & Lloyd, R. S. (2017). Hopping and Landing Performance in Male Youth Soccer Players: Effects of Age and Maturation. *International Journal of Sports Medicine*, 38(12), 902–908. <https://doi.org/10.1055/s-0043-114009>
- Read, P. J., Oliver, J. L., De Ste Croix, M. B. A., Myer, G. D., & Lloyd, R. S. (2019). A Review of Field- Based Assessments of Neuromuscular Control and Their Utility in Male Youth Soccer Players. In *Journal of Strength and Conditioning Research* (Vol. 33, Issue 1). <https://doi.org/10.1519/JSC.0000000000002069>
- Rubley, M. D., Haase, A. C., Holcomb, W. R., Girouard, T. J., & Tandy, R. D. (2011). The Effect Of Plyometric Training On Power And Kicking Distance In Female Adolescent Soccer Players. *Journal OfStrength and Conditioning Research*, 25(1), 129–134.
- Slimani, M., Chamari, K., Miarka, B., Vecchio, F. B. Del, & Chéour, F. (2016). Effects of Plyometric Training on Physical Fitness in Team Sport Athletes : A Systematic Review. *Journal of Human Kinetics.*, 53(September), 231–247. <https://doi.org/10.1515/hukin-2016-0026>
- Thomas, K., French, D., & Hayes, P. r. (2009). The Effect Of Two Plyometric Training Techniques On Muscular Power And Agility In Youth Soccer Players. *Journal of Strength and Conditioning Research*.