

## Single leg hop and double leg hop exercises on leg muscle strength on leg power for soccer athletes

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### Abstract

plyometric exercises on increasing leg power; (2) the difference in the effect between athletes who have high leg muscle strength and low leg muscle strength on leg power; and (3) the interaction between plyometrics (single leg hop and double leg hop) and leg muscle strength (high and low) on increasing leg power in soccer players. This type of research is an experiment using a 2 x 2 factorial design. The population in this study were 38 players from SSB Real Madrid UNY, which were taken based on purposive sampling technique and included as research subjects. The instruments in this study were leg and back dynamo meters and leg power using vertical jumps. The data analysis technique used is a two-way ANOVA. The results showed that: (1) There was a significant difference between single leg hop and double leg hop plyometric exercises on increasing leg power in soccer players, with F value 17.610 and  $p < 0.05$ . The single leg hop plyometric exercise group was better than the double leg hop group, with an average difference of 1.9 cm. (2) There is a significant difference in the effect between athletes who have high leg muscle strength and low leg muscle strength on leg power in soccer players, with F value 14.098 and  $p < 0.05$ . Athletes who have high leg muscle strength are better than athletes who have low leg muscle strength, with an average posttest difference of 1.7 cm. (3) There is a significant interaction between plyometrics (single leg hop and double leg hop) and leg muscle strength (high and low) on increasing leg power in soccer players, with F value 46,878 and  $p < 0.05$ .

**Keywords: single leg hop, double leg hop, leg power, leg muscle strength**

### Introduction

Football has become a very popular sport in the universe or the universe, including Indonesia (Jijon, 2017; Larasaty, 2018). Football is also a type of team sport that is liked by many people, both teenagers, young and adults in many countries (Zainuddin et al., 2022). The sport of football is a magnet for all people, without having to be a bear person who plays this sport, but football provides unlimited space for all people to enjoy the sport (Poulton & Durell, 2016). Soccer can be played indoors or outdoors, and soccer is a team game, and each team has eleven players including the goalkeeper. Patterns in the game of football are inseparable from the techniques, tactics and strategies applied by most professional coaches to achieve team goals in a competition (Francia et al., 2022). Almost all of these games use the feet, except the goalkeeper (Gong, 2020; Müller & Mutz, 2019). This sport requires good physical players, because physical condition is the main foundation for soccer players (Candra, 2016; Womsiwor et al., 2020; Zein et al., 2020). Quality physical conditions are like two aspects that apply in the physical education learning process, namely aspects of physical fitness and aspects of motor skills, because these two aspects cannot be separated from their important role in PE learning (Khairuddin et al., 2022)

In addition to physical, as for non-technical things in this game, for example, if a player wants to be successful, he does not only train hard in the sense that there is not only one factor, but there are several factors that affect the player's achievement such as genetic factors, discipline, practice, and luck. (Bista et al., 2016). Modern football in an official competition the players must have physical and physiological standards, in addition to the technical and tactical abilities of the players (Terekli & Çobanoğlu, 2019). Because he has excellent, good physical condition and a high level, it is a positive thing for players to concentrate fully in a match and follow directions given by a manager or coach. (Such et al., 2020). Football and the physical condition of a player are a vital component that cannot be separated, because a player excels if he is in excellent physical condition and does not experience physical disturbances (Pavlova et al., 2018).

Various types of physical abilities possessed by a football player, both amateur and professional, such as balance, agility, endurance, speed, including power. (Kruszewski et al., 2017). Power is a combination of two elements, namely strength and speed in a player, power is a maximally focused muscle strength in a very short time. Power in this study is dominant in leg power, leg power plays an important role in this game, because some

movements are carried out using the legs (Ferdiana et al., 2020; Kagan, 2016). The game of football is very synonymous with the main movement is kicking (Aktug & Iri, 2018; Tuyls et al., 2021) When a player makes a kicking motion, the body part that plays an important role is the foot, so the leg power has a major role in the success or failure of the kick towards the shot or target. (Trenev, 2021). Because by using leg muscle power properly, the ball is automatically directed to the right target (London et al., 2014).

Having an ideal body does not guarantee that an individual will become an accomplished soccer athlete, this the researchers found when conducting a pre-study by conducting a vertical jump test, the results were not good even though the football players of SSB Real Madrid UNY had a fairly ideal posture. Thus, it is necessary to improve the method of physical exercise so that it has a positive impact on maximum leg muscle power. Another discrepancy is that SSB Real Madrid UNY players make a lot of mistakes when competing, for example, their passing is less accurate, losing to aerial duels because the opponent's jump is higher than the player's and kicks are weak and not hard while hard but not on target. The main factor in jumping is leg power, in addition to muscle strength, speed of nerve stimulation, muscle contraction, biochemical energy production and movement mechanics (Rodríguez-Rosell et al., 2017). The problem that occurs is that there is no appropriate training method for SSB Real Madrid UNY players related to increasing leg power. The method used so far by the coach is more on technique and tactics in the match, then ignores leg power even though leg power is the main basis for kicking towards the target. Exercise in a sport, including football, must cover all aspects needed by a player, for example, exercises to increase leg muscle power, it is necessary to involve other muscles and use effective and efficient training methods. players will get a positive impact (Doewes et al., 2020; González & Sánchez, 2018). The principles in training must be understood by a coach, including the intensity of the exercise. Systematic and organized training can improve a variety of athletes' abilities, including leg muscle power. Various forms of training that can be used by a coach to overcome the gaps that are owned by players or athletes in the world of sports, including football. For example, in this study, researchers examined single leg hop and double leg hop plyometric exercises.

Plyometrics is a form of method needed by all types of sports in improving some of the abilities of players or athletes such as agility, speed, endurance, biometrics and strength. (Jidovtseff et al., 2014; Nikolic, 2018). Most sports apply this method in the main training to increase speed, strength and power (Fischetti et al., 2018). It is very good for training the muscles of athletes, because it forces the muscles to contract quickly and dynamically. The plyometric method can also be known as jump training by directing maximum strength in fast or short time intervals (van de Hoef et al., 2020). The main goal in this method is to increase speed and strength or often called power. Exercise using this method focuses more on training to move muscle function from the existence of contraction quickly Single leg hop and double leg hop exercises are methods specifically designed to increase the strength of leg muscle power in athletes in all sports, such as martial arts, volleyball, futsal, basketball and football the stronger, with the higher the intensity of the exercise, the greater the pressure created by the cells. Activated cells produce more collagen, osteocalcin, and other substances that make bones stronger (Kuibida et al., 2021).

The single leg hop method is a physiotherapy exercise. This training method is that the players are directed to run on one leg with a maximum jump, the exercise is done repeatedly. This method also develops explosive leg and hip muscles, including the gluteals, hamstrings, quadriceps and gastrocnemius muscles at high speed and full strength. This method is also very suitable for developing leg muscle explosive power. Because this method makes a good contribution to the explosive power of the leg muscles. Double leg speed hop is an exercise to jump as high as possible using two legs simultaneously towards the front to increase the speed and power of the leg muscles. This exercise focuses more on leg muscles such as the hips, quadriceps, hamstrings, and calf muscles. The previous research that became the basis for the comparative research of researchers is research. With the title double leg hop plyometric exercise can improve long distance kicks. The results of this study focused on increasing long-distance kicks, so there was a difference with research by researchers who used two training methods to increase leg muscle power.

Study (Arifin & Warni, 2020). Increasing the agility and speed of the results of this study when using the plyometric method the players experienced an increase in speed and agility in running, passing and kicking towards the target, thus there was a difference with the research of researchers who used two training methods to increase leg power while previous researchers used one method. training but the focus is on improving agility and speed in soccer athletes. Study (Usba, 2017). Leg muscle strength training through the double leg hop method for youth soccer athletes. The results showed that there was an influence of the exercise method used. The difference with this study is that the aspects studied by previous researchers focused only on leg muscle strength while researchers focused on leg power "a combination of strength and speed".

The importance of this research is to provide an effective, efficient, systematic and organized training method. By doing this research and then answering the problems faced by the football athletes of SSB Real Madrid UNY, through experiments that researchers have done in this study. The purpose of this research is whether the two methods used in this study can increase leg muscle power in soccer athletes.

Two factors that often affect the physical condition of the players or athletes are internal factors and external factors (Hettinga et al., 2017; Kakavas et al., 2020). These two factors are always attached to the

achievements of a football player. Internal factors include genetics, healthy lifestyle, nutritional adequacy, psychological, intellectual, emotional, mental, motivational and hormonal maturity. While external factors include small-scale and large-scale environments, in terms of the family environment, schools, places of practice and peers. When these two factors are owned by a football player, it is automatically ensured that the players have a great chance of becoming a successful individual and professional player. Departing from the problems that occurred to the football players of SSB Real Madrid UNY, the researchers were interested in researching with the title "the effect of single leg hop and double leg hop exercises on muscle strength of the limbs on increasing leg power of football players"

### Methods

This study uses an experiment with a factorial design 2x2 (Mutz & Pemantle, 2015). This method is testing in the sense that whether or not the influence of one variable with another variable. Factorial experiments are variations between group designs consisting of two or more treatment variables in testing independent variables and simultaneous effects on treatment variables to obtain results or outcomes. the place in this research is the football school of Real Madrid, Yogyakarta State University.

The population in this study was the entire sample of 38 football players. Subjects in this study amounted to 38 people who will be given treatment. Data collection techniques in this study were tests and measurements, with pretest and posttest treatment. The data analysis technique in this study was using SPSS version 20 with a two-way ANOVA approach with a significance level of 0.05. Prior to the operation stage using ANOVA, the data must go through prerequisite tests which include normality tests and homogeneity tests. The time in this study is March the 1st of 2021 ending in April the 9th of 2021. The table below is the design in this study.

**Table 1.** Research Design

Exercise Method (A) Muscle Strength Limb (B)	Single Leg Hop (A1)	Double Leg Hop(A2)
Height (B1)	A1. B1	A2. B1
Low (B2)	A1. B2	A2. B2
description		
A1B1:	Players who are trained using the single leg hop exercise method with high leg muscle strength	
A2B1:	Players who are trained using the double leg hop exercise method with high leg muscle strength	
A1B2:	Players who are trained using the single leg hop exercise method with low leg muscle strength	
A2B2:	Players who are trained using the double leg hop exercise method with low leg muscle strength	

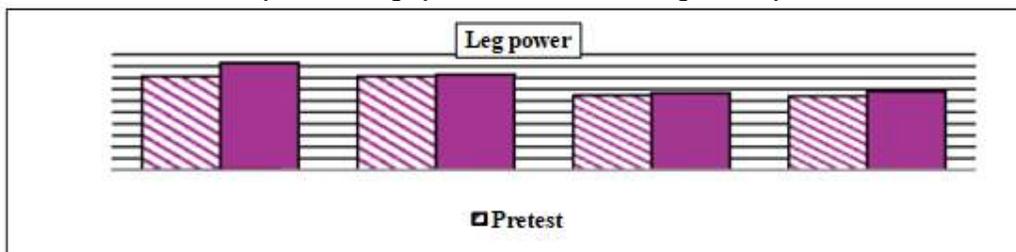
### Results

The result of calculating the average standard deviation and variance. Based on the results of research data processing, the average score (mean), standard deviation and variance of each test (initial test and finaltest) is obtained as presented in table 3 below:

**Table 2.** Descriptive Statistics of Pretest and Posttest of Leg Power

Group	Minimum	Maximum	Sum	Mean	Std. Deviation
Pretest A1B1	39,00	42,00	203,00	40,60	1,14
Posttest A1B1	44,00	48,00	232,00	46,40	1,52
Pretest A2B1	39,00	42,00	203,00	40,60	1,34
Posttest A2B1	40,00	43,00	207,00	41,40	1,14
Pretest A1B2	28,00	36,00	162,00	32,40	3,36
Posttest A1B2	28,00	37,00	167,00	33,40	3,58
Pretest A2B2	27,00	36,00	160,00	32,00	3,67
Posttest A2B2	30,00	37,00	171,00	34,20	3,11

The data in table three is then presented in graphical form to describe leg muscle power.



**Figure 1.** Pretest and Posttest Limb Power

Figure 1 above shows that the power of the A1B1 group with an average pretest of 40.60 cm then increased in the posttest by 46.40cm, the A2B1 group with an average pretest of 40.60 cm then increased in the posttest by 41.40, group A1B2 the average value of 32.40 cm then experienced an increase in posttest by 33.40 cm, group A2B2 the average pretest of 32.00 cm then experienced an increase in posttest of 34.20 cm. then proceed with the results of the prerequisite test which includes the normality test and homogeneity test which are presented in tables 4 and 5 below.

The normality test of the data in this study used the Shapiro-Wilk method. The results of the normality test of the data were carried out in each group, then the analysis used the software program SPSS version 20.0 for windows with a significance level of 5% or 0.05. The results of the normality test are presented in table 4 below.

Table 3. Summary of Normality Test

Group	Signifikansi	Information
Pretest A1B1	0,814	Normal
Posttest A1B1	0,492	Normal
Pretest A2B1	0,201	Normal
Posttest A2B1	0,814	Normal
Pretest A1B2	0,677	Normal
Posttest A1B2	0,685	Normal
Pretest A2B2	0,787	Normal
Posttest A2B2	0,332	Normal

Based on the analysis of the normality test data using the Shapiro-Wilk test, it showed that all the pretest and posttest leg power data with a significance value of  $p > 0.05$  were normally distributed. After performing the normality test, the next test was the homogeneity test. Homogeneity test was conducted to test the similarity of variance between pretest and posttest. The homogeneity test in this study used the Levene Test, and is presented in table 5 below.

Table 4. Homogeneity Test

F	df1	df2	Sig.
0,6	3	16	0,582
72			

The results of the statistical analysis of the homogeneity test using the Levene Test Wilk test with a significance value of 0.707 0.05, thus the data in this study is homogeneous. After the data in this study is declared homogeneous, then the hypothesis is revealed, the hypothesis in this study uses two-way ANOVA (two-way ANOVA). The data hypotheses are presented in table 6 below.

Table 5. Significance Test for increasing leg muscle power in single leg hops and double leg hops

Source	Type III Sum of Squares	Df	Mean Square	F	Sig
Exercise Method	18,050	1	18,050	17,610	0,001
Limb Muscle Strength	14,450	1	14,450	14,098	0,002
Limbs Strength Training Method	48,050	1	48,050	46,878	0,000

Based on the results of these hypotheses, it can be concluded that there is a significant interaction between plyometric single leg hop and double leg hop and high and low muscle strength on increasing leg muscle power in soccer players. The last test in this study is the Tukey test, then the results are presented in table 7 below

Table 6. Tukey HSD Test Results

Leg power		Subset	
Tukey HSD			
Workout Weights	N	1	2
A2B1	5	.8000	
A1B2	5	1.0000	
A2B2	5	2.2000	
A1B1	5		5.8000
Sig.		.169	1.000

Based on the results of the Tukey HSD test in Table 7 above, it can be explained that the differences in each group can be seen from the harmonic mean values produced by each group in the subset column. The test results above show that group A1B1 (players trained using the single leg hop training method with high leg muscle strength) is in a different subset column (column subset 2). Based on this, it can be concluded that the increase in leg power in the A1B1 group (Players who are trained using the single leg hop exercise method with high leg muscle strength) is better than the A2B1 group (Players who are trained using the double leg hop exercise method with high leg muscle strength), the group A2B1 A1B2 (Players trained using the single leg hop training method with low leg muscle strength), and group A2B2 (Players trained using the double leg hop training method with low leg muscle strength).

## Discussion

Based on hypothesis testing, it is known that there is a significant difference in the effect of single leg hop and double leg hop plyometric exercises on increasing leg power in soccer players. The single leg hop plyometric exercise group was better than the double leg hop exercise group, with an average difference of 1.9 cm. According to the biomechanical analysis, the single leg hop movement involved more muscle groups in the lower limbs than the double leg hop movement. The single leg hop movement puts more stress on the hip, leg and lower back muscles, and also engages the muscles that balance the knees and ankles.

Single leg speed hop training provides a significant increase in leg muscle explosive power. Plyometric single leg speed hop exercises develop explosive power for the muscles of the legs and hips, especially the gluteals, hamstrings, quadriceps and gastrocnemius muscles at high speed and full of power. This exercise requires more weight for the hip, leg and lower back muscles, and also involves the muscles that balance the knees and ankles. This happens because in practice it only uses one leg where the load in the exercise is only supported by one leg, so the role of the knee and ankle balancing muscles is also needed to maintain balance during exercise so as not to fall when landing. This finding is supported by several previous studies .

Single leg jump progression is more effective than double leg jump progression. This finding is consistent with some previous evidence. Single leg hop is more effective than double leg hop. Recent findings support the hypothesis that single leg jumps and double leg jumps can increase the speed and explosive power of leg muscles (Kusnanik & Isnaini, 2015: 2). Purwanto (2018: 12) shows that giving the single leg hop progression exercise method has a better effect than double leg hop progression training on increasing leg muscle explosive power in extracurricular athletes at SMA Negeri 1 Palu. Baro & Sonowal (2014: 877) which states that plyometric exercises (squat jump, split jump (lounges), depth jump, jump up, box jump march, lateral jump (single leg), and lateral jump over the cone (double leg) for 6 weeks that can increase explosive strength, speed and agility. *Plyometric* adalah jenis metodologi pelatihan yang dikenal sebagai "Latihan" yang dapat meningkatkan daya ledak dan kelincahan. Latihan pliometrik refers to exercises characterized by strong muscle contractions in response to rapid and dynamic loading. Plyometric training is an integral part of the training component that many fitness specialists use to optimize strength and power performance in several sports. The effects of muscle hypertrophy will result in an increase in leg muscle strength.

The increase in muscle strength is caused by an increase in the amount of contractile proteins, actin and myosin filaments and increases the strength of connective tissue and ligaments. In addition to increasing the strength of the leg muscles, the speed of the leg muscles will also increase with the presence of jumping movements that are carried out 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.

There is a significant difference in the effect of players who have high and low leg muscles on power in football games, this is evidenced by  $F 14.098$   $P < 0.05$ . Strength is a part of body composition that must be possessed by both amateur and professional athletes. In forming quality muscle strength, an individual must practice continuously and apply a healthy lifestyle and high discipline attitude so that he becomes an accomplished athlete. Considering that muscle strength is very important for an athlete, as early as possible, athletes are taught the right and correct method so that it does not cause various obstacles in the golden days, for example, experiencing injuries due to applying inappropriate training methods in training sessions.

An individual's muscle strength in physiological science, muscle strength is always directly proportional to the volume or size of the muscle that an individual has. Because the greater the muscle volume, the stronger or larger, the muscles contract maximally in carrying out a movement (Indrayana, 2018). Muscle strength has various components such as motor neurons. Motor neurons are collections of muscle fibers which are then innervated. The number of muscle fibers per unit and the number of muscle motor units that an individual has are very different. When a person performs rough and strong movements, they can produce motor neurons of 1500-200 muscle fibers. So it can be concluded that if muscle fibers can play a lot when an athlete makes a movement, the results are good and strong, for example kicking, and passing the ball.

The muscles of the upper limbs are defined as a collection of muscles that are very perfect and overlap each other . These muscles act as the main driving force of the shoulder and maintain body balance. Then the lower leg muscles are a collection of lower muscles that are in charge of straightening the body. In the leg muscles have the posterior aspect of the trunk, inferior to the neck and superior to the buttocks. Leg muscles include skin, muscles, vertebral column, ribs, spinal cord, nerves and segmental blood vessels.

significant interaction between plyometric (single leg hop and double leg hop) and leg muscle strength (high and low) on increasing leg power in soccer players, with  $F$  value 46,878 and  $p < 0.05$ . The results showed that the single leg hop plyometric exercise group was a more effective method for athletes with high leg muscle strength and the double leg hop exercise group was more effective for athletes with low leg muscle strength. From the results of the form of interaction, it appears that the main research factors in the form of two factors show a significant interaction. In the results of this study, the interaction means that in each cell or group there is a difference in the influence of each paired group. The drawback in this study is that the application of treatment for all groups is not collected or quarantined, so there is no control over what activities the sample does outside

of training, but rather stay in their respective homes. Indirectly this can affect the results of the study, there is no control over the sample, so that interactions and exercises can occur alone or together with exercises that are not treated and the current pandemic makes the procedure for carrying out exercises according to health protocols.

### Conclusion

Each coach has their own way and method of training to improve the various physical conditions of their athletes. The method that will be used by a professional coach is definitely a method that is full of simplicity but can have a big impact on the physical condition of soccer athletes. Single leg hop and double leg hop exercises are two methods that are often used by professional trainers, including Indonesian coaches. Single leg hop and double leg hop exercises are methods specifically designed to increase the strength of leg muscle power in athletes in all sports, such as martial arts, volleyball, futsal, basketball and football. The stronger, with the higher the intensity of the exercise, the greater the pressure created by the cells. Activated cells produce more collagen, osteocalcin, and other substances that make bones stronger.

Based on the results of the research and the results of the data analysis that has been carried out, the following conclusions are obtained. There is a significant difference in the effect of single leg hop and double leg hop plyometric exercises on increasing leg power in soccer players, with F values 17.610 and  $p < 0.05$ . The single leg hop plyometric exercise group was better than the double leg hop exercise group, with an average difference of 1.9 cm. There is a significant difference in the effect between athletes who have high leg muscle strength and low leg muscle strength on leg power in soccer players, with F values of 14.098 and  $p < 0.05$ . Athletes who have high leg muscle strength are better than athletes who have low leg muscle strength, with an average posttest difference of 1.7 cm. There was a significant interaction between plyometrics (single leg hop and double leg hop) and leg muscle strength (high and low) on increasing leg power in soccer players, with F value 46,878 and  $p < 0.05$ . The results showed that the single leg hop plyometric exercise group was a more effective method for athletes with high leg muscle strength and the double leg hop exercise group was more effective for athletes with low leg muscle strength.

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### References

- Aktug, Z. B., & IRI, R. (2018). The Effect of Motor Performance on Sportive Performance of Children in Different Sports Branches. *Asian Journal of Education and Training*. <https://doi.org/10.20448/journal.522.2018.42.75.79>
- Bista, B., Shrestha, S., & Gyawali, B. (2016). Factors associated with Myopia among Children at Eye Hospital Kathmandu. *Journal of Manmohan Memorial Institute of Health Sciences*. <https://doi.org/10.3126/jmmihs.v2i10.15798>
- Doewes, R. I., Purnama, S., Syaifullah, R., & Nuryadin, I. (2020). The effect of small sided games training method on football basic skills of dribbling and passing in Indonesian players aged 10-12 years. *International Journal of Advanced Science and Technology*.
- Ferdiana, I., Muhammad, M., & Wiriawan, O. (2020). Effect of Exercise Countermovement Jump and Depth Jump against the Increase Agility and Leg Muscle Power. *Budapest International Research and Critics in Linguistics and Education (BirLE) Journal*. <https://doi.org/10.33258/birle.v3i4.1509>
- 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*. <https://doi.org/10.7752/jpes.2018.04372>
- Francia, P., Marini, C. F., Bocchi, L., Piccini, B., Seghieri, G., Federici, A., Toni, S., & Lucertini, F. (2022). A six-month unsupervised training program does not improve ankle joint mobility in soccer players. *Journal of Physical Education and Sport*, 22(9), 2197–2205. <https://doi.org/10.7752/jpes.2022.09280>
- Gong, Y. (2020). Reading European football, critiquing China: Chinese urban middle class fans as reflexive audience. *Cultural Studies*. <https://doi.org/10.1080/09502386.2019.1633370>
- González, J. R., & Sánchez, J. S. (2018). Strength training methods for improving actions in football. *Apunts. Educacion Fisica y Deportes*. [https://doi.org/10.5672/apunts.2014-0983.cat.\(2018/2\).132.06](https://doi.org/10.5672/apunts.2014-0983.cat.(2018/2).132.06)
- Hale, D., Kollock, R., Pace, J., & Sanders, G. (2019). Vertical jump and agility performance improve after an 8-week conditioning program in youth female volleyball athletes. *Journal of Physical Education and Sport*. <https://doi.org/10.7752/jpes.2019.01109>
- Jijon, I. (2017). The moral glocalization of sport: Local meanings of football in Chota Valley, Ecuador. *International Review for the Sociology of Sport*. <https://doi.org/10.1177/1012690215572854>
- Kagan, R. A. (2016). Electrocution of Raptors on Power Lines. *Veterinary Pathology*.

- <https://doi.org/10.1177/0300985816646431>
- Khairuddin, Alnedral, Komaini, A., Syharastani, & Masrun. (2022). Effect of learning approach and motor skills on physical fitness. *Journal of Physical Education and Sport*, 22(9), 2273–2280. <https://doi.org/10.7752/jpes.2022.09289>
- Kruszewski, M., Kruszewski, A., Kuźmicki, S., Korczak, R., Tabęcki, R., Landowski, K., & Sitek, P. (2017). The effectiveness of kettlebell exercises in the aspects of special efficiency training in American football. *Baltic Journal of Health and Physical Activity*. <https://doi.org/10.29359/bjhpa.09.3.05>
- Kuibida, V., Kokhanets, P., & Lopatynska, V. (2021). Mechanism of strengthening the skeleton using plyometrics. *Journal of Physical Education and Sport*, 21(3), 1309–1316. <https://doi.org/10.7752/jpes.2021.03166>
- Larasaty, G. (2018). Headline's Meaning in On-Line Football Sport News. *Wiralodra English Journal*. <https://doi.org/10.31943/wej.v2i1.20>
- London, A., Németh, J., & Németh, T. (2014). Time-dependent network algorithm for ranking in sports. *Acta Cybernetica*. <https://doi.org/10.14232/actacyb.21.3.2014.13>
- Millar, S. R., Power, M. J., Widdop, P., Parnell, D., & Carr, J. (2021). Introduction: Football and popular culture. In *Football and Popular Culture: Singing Out from the Stands*. <https://doi.org/10.4324/9781003002604-1>
- Müller, J., & Mutz, M. (2019). On the Search for Social Esteem: An Ethnography on the Meanings of Football for Marginalized Male Migrants. *Young*. <https://doi.org/10.1177/1103308818805595>
- Mutz, D. C., & Pemantle, R. (2015). Standards for Experimental Research: Encouraging a Better Understanding of Experimental Methods. *Journal of Experimental Political Science*. <https://doi.org/10.1017/XPS.2015.4>
- Nikolic, A. (2018). Plyometric basketball training. *Turkish Journal of Kinesiology*. <https://doi.org/10.31459/turkjkin.468867>
- Pavlova, V. I., Kamskova, Y. G., Tyumaseva, Z. I., Saraykin, D. A., & Nikolaev, A. S. (2018). Development of physical qualities in children of primary school at playing football. *Journal of Pharmaceutical Sciences and Research*.
- Poulton, E., & Durell, O. (2016). Uses and meanings of ‘Yid’ in English football fandom: A case study of Tottenham Hotspur Football Club. *International Review for the Sociology of Sport*. <https://doi.org/10.1177/1012690214554844>
- Rodríguez-Rosell, D., Mora-Custodio, R., Franco-Márquez, F., Yáñez-García, J. M., & González-Badillo, J. J. (2017). Traditional vs. Sport-specific vertical jump tests: Reliability, validity, and relationship with the legs strength and sprint performance in adult and teen soccer and basketball players. *Journal of Strength and Conditioning Research*. <https://doi.org/10.1519/JSC.0000000000001476>
- Such, E., Burton, H., Copeland, R. J., Davies, R., Goyder, E., Jeanes, R., Kesterton, S., Mackenzie, K., & Magee, J. (2020). Developing a theory-driven framework for a football intervention for men with severe, moderate or enduring mental health problems: a participatory realist synthesis. *Journal of Mental Health*. <https://doi.org/10.1080/09638237.2019.1581339>
- Terekli, M. S., & Çobanoğlu, H. O. (2019). Mental Education of Football Referees: Mental Suitcase of Modern Football Referees. *International Education Studies*. <https://doi.org/10.5539/ies.v12n3p105>
- Trenev, L. (2021). Impact through the activities with different types of sports included in the “children’s camp of arts and sports 2020” organized by the student district on the physical activity of children 9-12 years old after the pandemic of Covid 19. *Series on Biomechanics*.
- Tuyls, K., Omidshafiei, S., Muller, P., Wang, Z., Connor, J., Hennes, D., Graham, I., Spearman, W., Waskett, T., Steele, D., Luc, P., Recasens, A., Galashov, A., Thornton, G., Elie, R., Sprechmann, P., Moreno, P., Cao, K., Garnelo, M., ... Hassabis, D. (2021). Game plan: What AI can do for football, and what football can do for AI. In *Journal of Artificial Intelligence Research*. <https://doi.org/10.1613/JAIR.1.12505>
- van de Hoef, P. A., Brauers, J. J., van Smeden, M., Backx, F. J. G., & Brink, M. S. (2020). The effects of lower-extremity plyometric training on soccer-specific outcomes in adult Male soccer players: A systematic review and meta-analysis. In *International Journal of Sports Physiology and Performance*. <https://doi.org/10.1123/ijpspp.2019-0565>
- Womsiwor, D., Adiputra, N., Bakta, I. M., Purba, A., Jawi, I. M., Ketut Suyasa, I., & Fitria, N. (2020). A Predominant Physical Component Profile of Persipura Junior Football Athletes. *Jurnal Pendidikan Jasmani Dan Olahraga*. <https://doi.org/10.17509/jpjo.v5i1.23792>
- Zainuddin, Z. H., Adnan, M. A., Mohamed, M. N., & Annur, M. S. S. (2022). Association between the pattern of play and the outcome of matches during the 2015 Asian Football Confederation (AFC) according to ball possession. *Journal of Physical Education and Sport*, 22(9), 1999–2004. <https://doi.org/10.7752/jpes.2022.09254>
- Zein, M. I., Saryono, S., Laily, I., & Garcia-Jimenez, J. V. (2020). The effect of short period high-intensity circuit training-modified FIFA 11+ program on physical fitness among young football players. *Journal of Sports Medicine and Physical Fitness*. <https://doi.org/10.23736/S0022-4707.19.09813-X>