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The effect of plyometric box drills on leg power in youth soccer players

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Abstract

The purpose of this study was to see the effect of plyometric box drill innovation on youth players at a leg power in soccer. This study used a quantitative approach, the type of research was experimental research, the research design used a non-rondomized group pretest-posttest, the sample numbered 65 players, while the leg power data was collected using a digital jump meter test instrument. The data gathered from participants were analyzed using SPSS software version 24, applying paired sample t-tests and independent sample t-tests with a significance level of 0.05. The results indicated that the two-tailed significance value was 0.000, which is below 0.05. This outcome suggests that the plyometric box drill innovation for youth soccer players had a statistically significant effect. The conclusion of this study states that the innovative plyometric box drill developed for youth soccer players at soccer schools in Tuban can increase leg power. This study showed that the plyometric box drill significantly improved the leg strength of young soccer players, which can be applied as an innovative training method in local soccer schools. The findings provide a basis for developing plyometric-based training programs that are more effective in preparing young players for the physical challenges in football.

Keywords: Plyometric, Box Drill, Soccer.

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Authors contribution: a – Preparing concepts; b – Formulating methods; c – Conducting research; d – Processing results; e – Interpretation and conclusions; f - Editing the final version.

INTRODUCTION

Observations at a youth soccer school showed that while some players were able to produce powerful and accurate kicks, others still struggled with the power and accuracy of their kicks. This highlights the importance of more focused training to improve players' long-distance kicking ability, given the need to cover most of the length of the soccer field in games. Observations made at the youth soccer school showed that, while some players were able to produce powerful and accurate

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kicks, others demonstrated less powerful and less precise kicks. Analysis of the average long kick distance of the youth players showed that the majority of their kicks did not exceed 50 meters. This fact raises concerns, given the dimensions of a soccer pitch, which is between 90 to 120 meters long and between 45 to 90 meters wide. Therefore, in the context of the game of soccer, it is essential to have a long-distance kicking ability that is able to cover at least 2/3 of the length of the field, even more, if possible.

Kicking the ball to a soccer player according to Sánchez et al. (2020), players who are able to kick the ball with good power and accuracy have a significant advantage in fast attack and defense situations. The skill differences in long-distance kicking, as observed in youth soccer schools, can be attributed to factors such as muscle strength and poorly developed kicking techniques. Ability in soccer players, according to Bahtra et al. (2020), emphasizes that differences in technical ability between young players usually stem from uneven training or poorly directed techniques. Kicking accuracy in soccer players, according to Cadenas-Sanchez et al. (2020), highlighted the importance of leg strength development and accuracy in long kicks. Their research shows that developing leg muscle strength and practicing the correct technique can increase the kicking distance as well as the level of accuracy, which is crucial in matches.

Soccer players at the youthshowed a disparity in their ability in terms of long-distance kicking, which manifested itself in both training and matches. These observations revealed variations, where some players were able to produce powerful and accurate kicks, while others exhibited less powerful and less precise kicks. The following is an observation of the long kick distance of soccer school youth players, 30m - 35m distance as much as 38% or 15 players, 36m - 40m distance as much as 28% or 11 players, 41m - 45m distance as much as 20% or 8 players, 46m - 50m distance as much as 12% or 5 players. This fact raises concerns, given the dimensions of the soccer field which has a length between 90 to 120 metres and a width between 45 to 90 metres. Therefore, in the context of

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soccer games, it is essential to have the ability to kick long distances that are able to reach at least 2/3 of the length of the field even more. The challenge in developing youth football players lies in their inability to fully optimise their potential in long-distance kicking, a skill that is crucial in football. Research shows that certain training methods can significantly improve long-distance kicking ability. For example, barrier hop training has been shown to be effective in increasing the power of gastric kicks in young players (Ramdani & Nurudin, 2022). This ability plays a vital role in various aspects of the game, such as keeping the ball out of danger zones, thwarting opposition attacks, scoring goals, and providing long-range passes to teammates. Despite their importance, many young players struggle to master these skills, mainly due to the lack of training methods targeted to meet their unique physical and technical needs. This gap underscores the importance of innovative approaches in the training and development of youth football players.

Technology-based approaches, such as data analysis and the use of advanced tools, have been implemented to improve the quality of training and accelerate the development of young players (Agustin & Muhtarom, 2024). In addition, the application of a game experience-based training model (Game Experience Learning) can improve the quality of skills and character of young football players (Makhlouf et al., 2018). The urgency of this study lies in its potential to revolutionize training methodologies by introducing scientifically designed programs tailored to the characteristics of young players. Such methods can not only improve the technical execution of skills such as long-distance kicking, but also enhance overall performance in matches. In addition, a well-structured training programme can minimize the risk of injury by taking into account the physiological and biomechanical limitations of young athletes. According to a study by Makaruk et al. (2024), a training programme that combines technical training with strength training and plyometrics can significantly improve kicking performance and reduce the risk of injury. In addition, a study by Markovic and Mikulic (2010) emphasizes the role of

neuromuscular coordination in enhancing explosive movements, which are crucial for effective long-distance kicking. Thus, developing innovative and evidence-based training methods has great significance for improving the quality of training, optimising the potential of youth football players, and shaping future achievements in this sport.

The importance of developing training methods tailored to the physical and technical needs of young soccer players has been supported by various studies. For example, Hammami et al. (2016) in their study explained that plyometric exercises, including plyometric box drills, are highly effective for improving various soccer performance metrics, such as muscular strength, explosive power, and movement speed. In addition, the study by Ramirez-Campillo et al. (2023) emphasizes that carefully designed plyometric training for young players can not only increase physical strength but also serve as a method of injury prevention by improving coordination and body control when performing explosive movements. Stojanović et al. (2017) also showed that plyometric training can improve neuromuscular control, which plays an important role in reducing the risk of injury in young players while improving technical abilities such as accurate and powerful long-distance kicks. Therefore, plyometric training based on a scientific approach is essential to achieve the dual goals of improving on-field performance and minimizing injury risk for young players.

METHOD

Study design.

This study utilized a pseudo-experimental design because the researcher could not fully control some of the independent variables that could affect the results, such as the resting time and daily food intake of each participant. To overcome these limitations, this study relied on observation of the effects of plyometric box drill training while considering these uncontrollable variables. Although participants were not given any direct intervention regarding resting time and diet, they were given

standardized instructions regarding resting time before each training session. They were asked to maintain their usual daily diet. In addition, participants were randomly selected to reduce bias, ensuring that the experimental and control groups had similar characteristics before the treatment was administered. Thus, although some external factors could not be fully controlled, this approach aimed to minimize their influence on the results of the study, allowing for a more objective evaluation of the effect of plyometric training on the leg strength of youth football players.

Table 1. Research design

Pretest Leg Power (Jump MD)	Treatment Plyometric Box Jump Box 10 inc 30 Tuches in 30 Seconds 16 Weex	Posttest Leg Power (Jump MD)

*MD: Meter Digital

This study uses an experimental design that assesses the effect of plyometric training (box jump) on increasing leg power. Measurements through pretest and posttest will provide an overview of whether the treatment given can produce positive changes in the explosive power of the participants' leg muscles.

Research Subjects

The main trial was conducted on players of Yong Boys, Semen Gresik Tuban, Putra Satria, Brawijaya Muda, consisting total subjects of 65 players, The criteria for selecting research subjects are as follows: 1) male gender, 2) aged between 10 and 15 years, 3) in good physical and mental health, and 4) committed to participating in all stages of the research until it is completed. In this main trial, the implementation of activities was guided by coaches who had previously been briefed through a Group Discussion Forum about the plyometric box drill innovation that had been developed.

Research Prosedure

The 16 weeks intervention program can be explained in Table 2, which explains the description of the treatment that will include week, day training intensity, description, set field, and rest.

Table 2. Treatmen plyometric box drill

Week	Day	Training	intensity	Description	Set	Fild	Rest
16	Monday, Wednesday, Friday	Plyometric Box Drill, 10 Inc	Hight	Duration 30 section 30 touches	3 Set	Sand	60 sec/Set

The training procedure arranged in the table shows a structured plyometric training program to improve the physical abilities of young soccer players. Training was conducted for 16 weeks at high intensity, carried out three times a week on Mondays, Wednesdays, and Fridays. Each session involved a Plyometric Box Drill with a duration of 30 seconds per set, where each set included 30 touches. The exercise was performed in three sets per session on sand, which provides additional resistance compared to hard surfaces. The use of sand as a training medium is designed to increase stabilizer muscle activation and strengthen leg muscles while reducing the risk of injury due to its soft and flexible nature.

This plyometric workout is designed to develop explosive strength and muscular endurance with a 60-second rest period between sets, which provides enough time for recovery without reducing the intensity of the workout. The main focus of this procedure is to train the muscles' ability to produce maximum power in a short period, which is particularly relevant for activities such as sprinting, jumping, or other explosive movements in soccer. With its consistent training duration and unique training terrain, this procedure provides a comprehensive approach to improve the physical performance of young soccer players significantly.

Instruments & measurement

The instruments in this study were utilized on two occasions: once during the pretest and again during the posttest, with the Jump MD used to assess leg power. The jump height results were then converted into the power formula. (Wismanadi et al., 2020).

$$p = \frac{m\ x\ g\ x\ h}{t}$$

P = power (in watts), m = mass (in kilograms), g = acceleration due to gravity (9.8 m/s²), h = height of the jump (in meters), t = time (in seconds).

(Haryono & Pribadi, 2013; McGinnis, 2013). The formula above is to enter data taken through the leg muscle power test conducted by the sample.

Techniques analysis

The techniques employed for data analysis included descriptive statistics, tests for data requirements (normality and homogeneity tests), and inferential analysis (paired sample t-test). This study conducted the data analysis using Microsoft Excel and SPSS 16.

RESULT

Players of soccer school Yong Boys conducted this research, soccer school Semen Gresik Tuban, soccer school Putra Satria, and soccer school Brawijaya Muda, with the number of players studied as many as 65 people. This research was conducted from 5 August 2024 to 5 October 2024. Then, the results of the research data description can be further explained in tabular form as follows:

Table 3. Description of pretest and posttest results on leg power youth player

	Score Leg Power		
	Pretest	**Posttest**	**Diference**
Mean	23266	27642	4376
Standar Deviasi	5294.4	6640,4	1346
Maxsimum	25721	48510	22789
Minimum	15190	18130	2940

Based on the analysis of the data obtained, it can be concluded that after the plyometric box drill intervention program, there was a significant increase in the participants' leg strength. Before treatment, the data showed a mean value of leg strength of 23.266 with a standard deviation of 5.294.4, a maximum value of 25.721, and a minimum value of 15.190. After treatment, the mean leg strength increased to 27,642.08, with a standard deviation of 6,640.4, a maximum value of 48,510, and a minimum value of 18,130. The mean increase of 4,376.08 indicates that plyometric training significantly contributed to the increase in leg strength, while the higher standard deviation after treatment indicates greater

variation in individual responses to training. This suggests that although the majority of participants experienced improvement, some individuals may have experienced greater improvement than others, possibly due to individual factors such as initial physical condition and level of adaptation to the exercise.

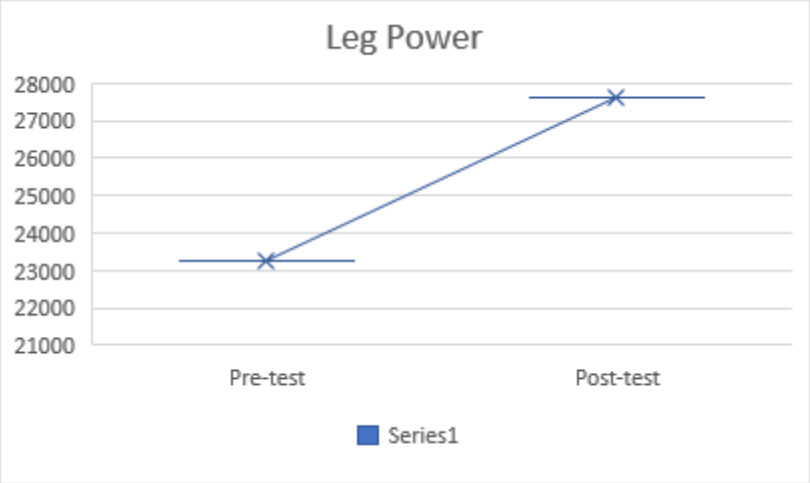

Figure 1. Histogram Deferance Pretest - Postes

In this study, a normality test was conducted to determine if the obtained data followed a normal distribution, using the Kolmogorov-Smirnov test. The decision criterion was based on an Asymp. A sig value of 5.033, which is greater than 0.05, indicates that the data can be considered normally distributed. The homogeneity test was performed using Levene's Statistic to assess whether the sample variances from the same population were consistent. The decision criterion here was an Asymp. A sig value of 4.82, also greater than 0.05, suggests that the data is homogeneous. To test the stated hypothesis, a mean difference analysis was performed using the Paired t-test.

Table 4. Result implementation t-test data analysis

Variabel	t	df	Sig.	Mean Diference
Innovation Of Plyometric Box Drill For Youth Soccer Players	-33.817	64	.000	4376

According to the table above, the t-test was conducted on the pretest and posttest leg power values. The data analysis revealed a t-count value

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of -33.8175, while the t-table value was 2.179, with a significance level of 0.000, which is less than 0.05. This indicates a significant difference. Since the t-count exceeds the t-table, this implies that the box drill training has led to an improvement in leg power among the youth players.

DISCUSSION

The focus of this research is to see the effect of the innovation of plyometric box drills on youth players at soccer schools in Tuban. The results showed that there was an increase in training using innovative plyometric box drills to increase leg power in youth players. Plyometric box drills are beneficial for soccer players because they can increase strength, explosive power, and overall performance (Konukman et al., 2022). Plyometric box drills can increase jump height, sprint speed, and endurance in adult male soccer players, as shown in a systematic review and meta-analysis (van de Hoef et al., 2020). Recent innovations in plyometric box drills have been developed to address long-distance kicking in soccer. Research shows that plyometric exercises on different surfaces, such as sand, lead to improvements in running, jumping, balance, and kicking distance in soccer players (Bonavolontà et al., 2021; Michailidis, 2015). Studies also highlight significant gains in speed, vertical jump, agility, and kicking distance after plyometric training (Ramirez-Campillo et al., 2019). A 16-week plyometric program has demonstrated improved vertical jumping ability and agility in soccer players (Fischetti et al., 2018). The plyometric box drill can be adjusted for intensity by changing the height of the box, ensuring that exercises match the developmental needs of youth players (Sundari & Sukadiyanto, 2019; Susantia et al., 2021).

The plyometric box training method in youth soccer lies in developing effective training methods to improve specific physical abilities required in the game, such as explosive power, agility, and jumping power. This research provides practical guidance in designing evidence-based training programs that are appropriate for the stage of physical development of young players, so that the results are more optimal and measurable. In

addition, training with plyometric boxes also contributes to improved stability and body control, which not only supports physical performance but also reduces the risk of injury in young players. By focusing on game-relevant skills, this research assists soccer coaches and academies in developing young athletes holistically, encompassing performance, safety, and readiness for competitive demands.

Plyometric exercises, like box drills, involve rapid muscle stretching and contraction, helping to boost explosive power. This is essential in soccer for activities like sprinting, jumping for headers, and swiftly changing direction. The explosive movements in plyometrics directly enhance the power required for these actions, allowing players to perform at higher intensity levels during matches (Wang & Zhang, 2016). Plyometric box drills and related exercises have been shown to improve leg power and strength across various sports effectively. Studies have demonstrated significant increases in leg power athletes using plyometric standing jumps and box drills (Susianti, Irawan, & Aswan, 2019) and for soccer players using box jump exercises (Sufahman, Dos Santos, Rijaluddin, Ilahi, & Fachrezzy, 2023). These findings suggest that plyometric box drills and related exercises can be valuable components of training programs aimed at improving leg power and performance in various athletic activities.

Plyometric jump training methods demonstrated significant improvements in jumping performance, reactive strength index, and acceleration performance among soccer players, given the challenges associated with integrating resistance training into soccer (Liu, Wang, & Xu, 2024). These programs typically start with 50-60 jumps per session, progressing to 100-120 jumps by the end (Michailidis, 2014). Studies have reported improvements in vertical jump height, agility, and knee extensor strength following plyometric training (Váczi et al., 2013; Zisis, 2013). When incorporated into regular soccer practice, plyometric training leads to greater performance gains compared to conventional soccer training alone (Michailidis, 2015; Pratiwi et al., 2018). The benefits extend to

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various aspects of soccer performance, including kicking ability (Michailidis, 2015). Overall, the evidence suggests that plyometric training is an effective method for enhancing motor performance in youth soccer players and should be considered a valuable addition to their training regimen.

Plyometric training has been shown to be very effective in increasing the explosive power required in sports such as soccer. Hammami et al. (2016) showed that plyometric exercises, including plyometric box drills, can improve various aspects of soccer players' performance, such as speed, agility, and kicking power. They highlighted the importance of plyometric training in improving players' leg strength and sprinting ability, which are indispensable in soccer. Söhnlein et al., (2014) also noted that plyometric training tailored to young players not only increases muscle explosiveness but can also reduce the risk of injury, which is important for young developing players. Milanovic & Belcic (2024) revealed that plyometric training can improve sprinting and vertical jumping ability, two very important skills in soccer. They also emphasized that progressive plyometric-based training helps players develop physical abilities that support performance on the soccer field. In the context of a 16-week intervention, this study provides a scientific basis for the design of intensive and gradual training programs to achieve optimal physical adaptation in young players.

Training methods tailored to the physical and technical needs of youth soccer players are crucial for enhancing match performance and minimizing injury risks. Plyometric exercises, including box drills, have been shown to improve various soccer performance metrics, such as jump height, leg strength, and acceleration. Research indicates that horizontal plyometric training contributes to injury prevention and enhances countermovement jump abilities, making it an essential component in youth training (Yanci et al., 2016). Furthermore, plyometric training has led to significant improvements in long jump ability and sprint speed in pre-teen soccer players (Michailidis, 2015; Wang & Zhang, 2016).

In addition to enhancing motor skills, plyometric training, including customized exercises, has been shown to improve soccer performance. Studies indicate that both squat jumps and plyometric box exercises are effective for increasing lower limb strength, with plyometric box drills offering benefits in strength, explosiveness, and overall performance (Chang et al., 2019; Konukman et al., 2022). These exercises, whether bilateral or unilateral, also significantly enhance muscular strength and endurance, essential for youth soccer players (Ramirez-Campillo et al., 2019). Overall, plyometric training can reduce the risk of injury while improving lower limb strength.

Plyometric training (PT) has been shown to improve various performance measures in soccer players significantly. Studies have demonstrated that 8-week PT programs can enhance leg power, jump height, and sprint performance in both male and female soccer players (Chelly et al., 2010; Ozbar et al., 2014). PT typically involves exercises utilizing the stretch-shortening cycle, such as hurdle and depth jumps (Chelly et al., 2010). These exercises contribute to improvements in vertical jump performance, acceleration, leg strength, muscular power, and overall sport-specific skills (Pratiwi et al., 2018). PT has been found to be particularly effective in developing explosive actions, which are crucial for soccer performance (Zisis, 2013). The benefits of PT have been observed across different age groups and skill levels, from amateur to professional players (Chelly et al., 2010; Ozbar, Ates, & Agopyan, 2014). Incorporating PT (Personal Training) into regular soccer training, even for short durations, can lead to significant improvements in athletic performance compared to standard in-season training alone (Chelly et al., 2010; Ozbar et al., 2014).

Results of the analysis above that the plyometric box drill innovation developed for youth players at the soccer school in Tuban can increase leg power, this is because the box drill exercise developed is designed based on the development and growth of adolescent children. In addition, plyometrics is The most widely used and efficient approach for building

power and is also highly effective in enhancing the neuromuscular system's reactive ability. When a muscle is stretched, it generates elastic strength. This is a physical process rather than a metabolic one. Box Jumps are a great exercise for improving reactive or eccentric strength.

Although this study showed positive results regarding the improvement of leg strength through plyometric box drill training, there are some limitations that need to be noted. One of the main limitations is the researcher's inability to fully control external variables such as rest time, food intake, and daily habits of the participants, which could affect the final results. Although participants were instructed to maintain a consistent diet and rest periods, these factors could still contribute to the variability of the observed results. In addition, the pseudo-experimental design used in this study did not allow for the establishment of a completely randomized control group, which could affect the internal validity of the results. The influence of other variables such as individual motivation, previous exercise experience, or participants' initial fitness level may also affect the results but could not be controlled for in this study.

This study opens up opportunities for further research into the effect of plyometric training on the physical performance of youth soccer players. Future research may consider controlling external variables such as nutritional intake and rest periods more strictly to explore their influence on training outcomes. In addition, using a more rigorous randomized experimental design with a more controlled control group will provide a clearer picture of the specific effects of plyometric training. Further research could also delve deeper into variations in individual responses to plyometric training, taking into account factors such as age, initial fitness level, and soccer experience. Furthermore, it could further investigate how plyometric training can contribute to the improvement of other technical skills in soccer, such as agility, speed, and endurance, and how it can be applied in the context of long-term soccer training.

This study demonstrated favorable outcomes in enhancing leg strength with plyometric box drill training; nonetheless, certain limitations

warrant attention. A primary drawback is the researcher's lack of complete control over external variables, like rest duration, dietary intake, and participants' daily routines, which may influence the final outcomes. Despite participants being directed to adhere to a uniform food and rest intervals, these elements may nevertheless influence the variability of the observed outcomes. The pseudo-experimental approach employed in this work precluded the formation of a fully randomized control group, potentially compromising the internal validity of the findings. The impact of additional variables, such as individual motivation, prior exercise experience, or participants' baseline fitness level, may also influence the outcomes but could not be accounted for in this study.

This study presents avenues for more research into the impact of plyometric training on the physical performance of youth soccer players. Future studies may rigorously regulate external variables, like as food intake and rest intervals, to examine their impact on training outcomes. Moreover, employing a more stringent randomized trial design with a better-controlled control group will elucidate the precise effects of plyometric exercise. Subsequent research could explore the disparities in individual reactions to plyometric exercise, considering variables such as age, baseline fitness level, and soccer experience. Additionally, it might examine how plyometric training enhances other technical qualities in soccer, like agility, speed, and endurance, and its application within the framework of long-term soccer training.

CONCLUSION

This study states that the plyometric box drill innovation developed for youth soccer players at the soccer school in Tuban can increase leg power. It also emphasizes that the plyometric box drill tool developed based on the development and growth of adolescent children can be accommodated properly and usefully. Future research can be done to provide plyometric exercises for the dominant leg.

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REFERENCES

Agustin, D., & Muhtarom, D. (2024). Pengaruh Peningkatan Power Otot Tungkai Terhadap Kecepatan Tendangan Lurus Tapak Suci Ekstrakurikuler SD Aisyiyah Kuningan tendangan lurus pada target yang telah disediakan . Hal ini dikarenakan siswa merasa kurang daya tahan kekuatan otot tungkai , power. *Harmoni Pendidikan : Jurnal Ilmu Pendidikan*, *1*(3), 162–172. https://doi.org/10.62383/hardik.v1i3.448

Bahtra, R., Asmawi, M., Widiastuti, & Dlis, F. (2020). Improved vo2max: The effectiveness of basic soccer training at a young age. *International Journal of Human Movement and Sports Sciences*, *8*(3). https://doi.org/10.13189/saj.2020.080304

Bonavolontà, V., Carvutto, R., Di Gioia, A., & De Candia, M. (2021). Plyometric training on sand versus grass: Effects on sprinting, jumping, agility and balance in soccer players. https://doi.org/10.14198/jhse.2021.16.Proc3.27

Cadenas-Sanchez, C., Migueles, J. H., Esteban-Cornejo, I., Mora-Gonzalez, J., Henriksson, P., Rodriguez-Ayllon, M., Molina-García, P., Löf, M., Labayen, I., Hillman, C. H., Catena, A., & Ortega, F. B. (2020). Fitness, physical activity and academic achievement in overweight/obese children. *Journal of Sports Sciences*, *38*(7). https://doi.org/10.1080/02640414.2020.1729516

Chang, K.-E., Zhanga, J., Huanga, Y.-S., Liu, T.-C., & Sung, Y.-T. (2019). Applying augmented reality in physical education on motor skills learning. *Interactive Learning Environments*, *28*(6), 685–697. https://doi.org/10.1080/10494820.2019.1636073

Chelly, M. S., Ghenem, M. A., Abid, K., Hermassi, S., Tabka, Z., Shephard, R. J. J. T. j. o. s., & research, c. (2010). Effects of in-season short-term plyometric training program on leg power, jump- and sprint performance of soccer players. *24*(10), 2670-2676. https://doi.org/10.1519/JSC.0b013e3181e2728f

Fischetti Francesco, Cataldi, S., & Greco, G. (2019). Lower-limb plyometric training improves vertical jump and agility abilities in

adult female soccer players. *19*(2), 1254-1261. https://doi.org/10.1007/s11332-019-00560-2

Hammami, M., Negra, Y., Aouadi, R., Shephard, R. J., & Chelly, M. S. (2016). Effects of an In-season Plyometric Training Program on Repeated Change of Direction and Sprint Performance in the Junior Soccer Player. *Journal of Strength and Conditioning Research*, *30*(12), 3312–3320. https://doi.org/10.1519/JSC.0000000000001470

Konukman, F., Erdogan, M., Tüfekçioglu, E., Gümüşdag, H., & Yılmaz, İ. (2022). Teaching Plyometric Soccer Drills to Children. *Journal of Physical Education, Recreation and Dance*, *93*(1), 55–57. https://doi.org/10.1080/07303084.2022.2006011

Liu, G., Wang, X., & Xu, Q. (2024). Microdosing Plyometric Training Enhances Jumping Performance, Reactive Strength Index, and Acceleration among Youth Soccer Players: A Randomized Controlled Study Design. *23*(2), 342. https://doi.org/10.52082/jssm.2024.342

Makaruk, H., Starzak, M., Tarkowski, P., Sadowski, J., & Winchester, J. (2024). The Effects of Resistance Training on Sport-Specific Performance of Elite Athletes: A Systematic Review with Meta-Analysis. *Journal of Human Kinetics*, *91*, 135–155. https://doi.org/10.5114/jhk/185877

Makhlouf, I., Chaouachi, A., Chaouachi, M., Othman, A. Ben, Granacher, U., & Behm, D. G. (2018). Combination of agility and plyometric training provides similar training benefits as combined balance and plyometric training in young soccer players. *Frontiers in Physiology*, *9*(NOV). https://doi.org/10.3389/fphys.2018.01611

Markovic, G., & Mikulic, P. (2010). Neuro-Musculoskeletal and Performance Adaptations to Lower-Extremity Plyometric Training. *Sports Medicine*, *40*(10), 859–895. https://doi.org/10.2165/11318370-000000000-00000

Michailidis, Y. (2015). Effect of plyometric training on athletic performance in preadolescent soccer players. *10*(1), 15–23. http://doi.org/10.1519/JSC.0b013e3182541ec6

Milanovic, L., & Belcic, I. (2024). The Effects of Additional Plyometric Training on Indicators of Subjective Training Load in Football. *Ann Appl Sport Sci*, *12*(8). https://doi.org/10.61186/aassjournal.1327

Ozbar, N., Ates, S., & Agopyan, A. (2014). The effect of 8-week plyometric training on leg power, jump and sprint performance in female soccer players. *28*(10), 2888-2894. http://doi.org/10.1519/JSC.00 0000000 0000541

Pratiwi, F. Z., Setijono, H., & Fuad, Y. (2018). Pengaruh Latihan Plyometric Front Cone Hops dan Counter Movement Jump Terhadap Power dan Kekuatan Otot Tungkai. *Jurnal SPORTIF :*

Jurnal Penelitian Pembelajaran, *4*(1), 105. http://ojs.unpkediri.ac.id/index.php/pjk/article/view/12073

Ramdani, Y., & Nurudin, A. A. (2022). Latihan Barrier Hops Untuk Meningkatkan Tendangan Jarak Jauh Pemain Akademi Football Babakan. *Jurnal Educatio FKIP UNMA*, *8*(4), 1478–1482. https://doi.org/10.31949/educatio.v8i4.2853

Ramirez Campillo, R., Alvarez, C., García-Pinillos, F., Gentil, P., Moran, J., Pereira, L. A., & Loturco, I. (2019). Effects of plyometric training on physical performance of young male soccer players: potential effects of different drop jump heights. *31*(3), 306-313. https://doi.org/ 10.1519/JSC.000000000000 0762

Ramirez-Campillo, R., Sortwell, A., Moran, J., Afonso, J., Clemente, F. M., Lloyd, R. S., Oliver, J. L., Pedley, J., & Granacher, U. (2023). Plyometric-Jump Training Effects on Physical Fitness and Sport-Specific Performance According to Maturity: A Systematic Review with Meta-analysis. *Sports Medicine - Open*, *9*(1). https://doi.org/10.1186/s40798-023-00568-6

Sánchez, M., Sanchez-Sanchez, J., Nakamura, F. Y., Clemente, F. M., Romero-Moraleda, B., & Ramirez-Campillo, R. (2020). Effects of plyometric jump training in female soccer player's physical fitness: A systematic review with meta-analysis. In *International Journal of Environmental Research and Public Health* (Vol. 17, Issue 23). https://doi.org/10.3390/ijerph17238911

Söhnlein, Q., Müller, E., & Stöggl, T. (2014). The Effect of 16-Week Plyometric Training on Explosive Actions in Early to Mid-Puberty Elite Soccer Players. *Journal of Strength and Conditioning Research / National Strength & Conditioning Association*, *28*(8). https://doi.org/10.1519/JSC.0000000000000387

Stojanović, E., Ristic, V., McMaster, D., & Milanović, Z. (2017). Effect of Plyometric Training on Vertical Jump Performance in Female Athletes: A Systematic Review and Meta-Analysis. *Sports Medicine*, *47*, 975–986. https://doi.org/10.1007/s40279-016-0634-6

Sufahman, M., Dos Santos, M. H., Rijaluddin, K., Ilahi, R., & Fachrezzy, F. (2023). The Effect Of Drill And Box Jump Exercises On Leg Power In Smash Back Attack Voleyball. *6*(2), 219-225. https://doi.org/10.31602 /rjpo. v6i2.12651

Sundari, A., & Sukadiyanto, S. (2019). Perbandingan metode latihan dan power otot lengan terhadap hasil tolak peluru. *Jorpres (Jurnal Olahraga Prestasi)*, *15*(1). https://doi.org/10.21831/jorpres.v15i1.26022

Susantia, R., Sidik, D. Z., Hendrayanac, Y., & Wibowo, R. (2021). Latihan Pliometrik dalam Meningkatkan Komponen Fisik: A Systematic Review. *JOSSAE (Journal of Sport Science and Education)* |, *6*(2), 156–171. https://doi.org/10.26740/jossae.v6n2

Susianti, E. E., Irawan, A. A. A., & Aswan, A. A. M. (2019). *Effect of Standing Jumps and Box Drills to Explosive Power in Momtong Dollyo Chagi.* Paper presented at the 2nd International Conference on Sports Sciences and Health 2018 (2nd ICSSH 2018).

Van de Hoef, P. A., Brauers, J. J., van Smeden, M., Backx, F. J., Brink, M. (2020). The effects of lower-extremity plyometric training on soccer-specific outcomes in adult male soccer players: a systematic review and meta-analysis. *15*(1), 3-17. https://doi.org/10.1123/ijspp.2019-0565

Váczi, M., Tollár, J., Meszler, B., Juhász, I., & Karsai, I. (2013). Short-term high intensity plyometric training program improves strength, power and agility in male soccer players. *Journal of Human Kinetics*, *36*(1), 17–26. https://doi.org/10.2478/hukin-2013-0002

Wang, Y.-C., & Zhang, J. (2016). Effects of plyometric training on soccer players. *12*(2), 550-554. https://doi.org/10.3892/ etm.2016.3419

Yanci, J., Los Arcos, A., Camara, J., Castillo, D., García, A., & Castagna, C. (2016). Effects of horizontal plyometric training volume on soccer players' performance. *24*(4), 308-319. https://doi.org/10.1080/15438627.2016.1222280

Zisis, P. (2013). The effects of an 8 weeks plyometric training program or an explosive strength training program on the Jump-and-Reach Height of male amateur soccer players. *Journal of Physical Education and Sport*, *13*(4), 594–600. https://doi.org/10.7752/jpes.2013.04093