

## Effect of 8-Weeks Plyometric Training and Combination of Core and Plyometric Training on Soccer Kicking Performance for Distance

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### Abstract

The purpose of the study was to analyze the effect of 8- weeks plyometric training and combined training on soccer kicking performance for distance in male soccer players. A total of 30 male players age ranged from 18-25 years, of interuniversity level were from LNIPE, Gwalior selected as subject. Thirty subjects were divided equally into three groups: plyometric training group, combined training group and control group. The purposive sampling technique was used to attain the objectives of the study. All subject, after having been informed objective of the study, gave their consent and volunteered to participate in this study. The training was carried out thrice a week on alternate days of the week for each group. The training programme was carried out for a total duration of eight weeks. The data was collected by administering the test of soccer ball kicking for distance. ANCOVA was applied as statistical technique to find comparative effect of plyometric training and combined training, the alpha level was set at 0.05. Statistical analysis of the data revealed there is significant difference in groups as the f value found significant ( $p < 0.000$ ), since f – statistics is significant, post hoc comparison has been made for the adjusted means of three groups. It may be noted here that p-value for mean difference between plyometric training and control group ( $p < 0.000$ ) and combined training and control group is ( $p < 0.000$ ). Also significant difference was found in plyometric training and combined training ( $p < 0.018$ ). Hence it may be inferred that combined training (combination of plyometric and core exercises) is most effective in improving soccer kicking performance for distance. Plyometric training is also effective in improving soccer kicking performance for distance among subjects in comparison to that of control group.

**KEYWORDS:** Training, Plyometric, Combined, Core, Exercises, Soccer, Distance, Performance

### Introduction

Soccer (also known as football) is the world's most popular form of sport, being played in every nation without exception. Soccer has a rich history though it was formalized as we know it today by the establishment of the Football Association in 1863. The game soon spread to continental European countries and later to South America and the other continents. The world's governing body, Federation International de Football Association (FIFA), was set up in 1904 (Thomas, 2003). Soccer requires athletes to perform short sprints, repeatedly change directions, and complete numerous jumps during a 90- min match (Krustrup et al., 2005; Stolen et al., 2005). Therefore, the assessment of linear sprinting, jumping, and agility are common to soccer (Hoare and Warr, 2000; Chamari et al., 2004).

Exercise is defined as some organized and regular activity that is done to enhance athletic performance (Stane, 2005) which is divided into different categories based on

athletics' performance necessities. Plyometric exercises and core stability exercises are among those various exercises which are used by athletes to improve their performance. Plyometric exercises are defined as the exercises and drills that employ the combination of speed and strength to increase relative explosive movements (Chu 1992; Pienaa and Coetzee 2013. Behrens et al. 2014), and are used to develop strength (Agaoglu et al. 2000; Potdevin et al. 2011. Pirainen et al. 2014). Plyometric are training techniques used by players in all types of sports to increase strength and explosiveness (Chu, 1998). Plyometric consists of a rapid stretching of a muscle (eccentric action) immediately followed by a concentric or shortening action of the same muscle and connective tissue (Baechle and Earle, 2000). The area named as "core" is the area including the abdominals in the front side of the body. In other words hypochondrium and hypogastrium muscles; serratuses is right next to hypochondrium muscles; obliques is right next to hypogastrium muscles; and the muscle groups from the waist to the neck that help the skeleton to have a correct posture (External Obliques, Internal Obliques, Transversus Abdominis, Multifidi Psoas). "Core training" refers to the training of the above mentioned abdominal and lumbar regions. Strengthening the core region is not only necessary for sportive endurance but it also provides a correct posture (Fahey et al. 2011; Weston et al. 2013; Qianyun et al. 2013; Weston et al. 2014). Kicking performance has been related to leg muscle strength (De Proft et al. 1988; Dutta and Subramaniam 2002; Jelusic et al. 1992; Manolopoulos et al. 2004). De Proft et al. (1988) noted that after a specific leg strength training program during a full football season the concentric strength of the knee increased and kick performance (measured as kicking distance) improved (De Proft et al. 1988). They also reported that the correlations between leg strength and kick performance improved from the beginning to the end of the season in adolescent football players.

Given inconsistencies and the lack of researches done in the past as well as the importance of this area, there is still the question of whether the plyometric training has a direct impact on kicking performance of soccer players? Whether is it possible to apply plyometric exercises and core exercises together for improvement of kicking performance of soccer players? What kind of exercises (combination of core and plyometric or plyometric) can affect kicking performance of soccer players and which one has priority over the other?

### **Selection of Subjects**

To systematize the study, subjects were divided into three groups (two experimental groups and one control group). A total of 30 male (10 players in each group) players age ranged from 18-25 years, of football match practice group were from LNIFE, Gwalior selected as subjects for the study. The purpose of the research was explained to all the subjects and subjects were motivated to put their best during each trial

### **Selection of Variables**

- Plyometric training
- Combined training ( plyometric and core)

### **Criterion Measures**

The criterion measure chosen for testing the hypothesis in this study was soccer kicking ability (lofted kick) for distance and it was recorded in meters and centimetres.

### **Selection of Exercise**

The research scholar went through the available literature pertaining to the training of soccer players using plyometric and core training and also after having discussion with the experts, the following exercises were chosen.

#### **Plyometric Training Exercises**

- Broad jumps
- Skater jumps
- Dot drill

#### **Combined training exercises ( combination of plyometric and core training)**

- Flat bench lying leg raise
- Barbell side bend
- Decline crunch Broad jumps
- Skater jumps
- Dot drill
- Broad jumps

#### **Experimental Design**

Pre test post test control group design was adopted for this study. Further the experimental treatments were also assigned at random to the two experimental group and last group served as a control group .The experimental groups participated in training program. The training programme was carried out for a total duration of eight weeks.

#### **Administration of Training Programme**

The training schedule prescribed by the researcher was applied to two experimental groups and training was personally supervised by the researcher and each day gave only one training either plyometric or combined was given. The training was carried out for a period of eight weeks, three days a week excluding the time consumed for conducting per-test and post test. The scholar demonstrated the training for experimental group. Each subject of the experimental group performed their respective training. Sufficient and required recovery was provided between the tests. The scholar demonstrated each exercise with its movement structure. The control group was not allowed to undergo the training program. From the first week to the eighth week, the volume of training load and training increased gradually for the experimental group.

#### **Administration of test**

##### **Soccer kicking for distance (lofted kick)**

Standard soccer ball was used for the test. The soccer ball was placed on a particular spot for each kick. The subject took an approach run and kicked a soccer ball for distance: where the ball dropped the scholar measured that distance from the center of the spot with the help of metallic tape. 5 (five) trials were given to each subject.

#### **Statistical Technique**

The differences in the means of two experimental groups and a control group in soccer ball kicking for distance or 'lofted kick' test ability was tested for

significance by applying Analysis of co-variance (ANCOVA), and the level of significance chosen was 0.05.

### Results

The mean and standard deviation of all the three groups i.e. plyometrics training, combined training and control group during post testing have been shown in table 1:-

**TABLE 1**  
**DESCRIPTIVE STATISTICS OF POST TEST OF KICKING**  
**PERFORMANCE FOR DISTANCE**

Groups	Mean	Std. Deviation	N
Plyometric Training	45.60	2.63	10
Combined Training	48.30	2.94	10
Control Group	41.50	4.17	10

Table 2 indicates mean and standard deviation of plyometric training group  $45.60 \pm 2.63$ , combined training group  $48.30 \pm 2.60$  and control group  $41.50 \pm 4.17$

**TABLE 2**  
**LEVENE'S TEST OF EQUALITY OF ERROR VARIANCES**

F	df1	df2	p-value
1.819	2	27	.181

To test the equality of variances, Levene's test was used. The F-value was insignificant as the p-value (.181) was more than 0.05. Thus the null hypothesis of equality of variances might be accepted, and it was concluded that the variances of the two groups were equal. The results were presented in Table 2.

The mean and standard deviation of different post testing groups after adjustment have been shown in table 3:-

The adjusted mean and standard error of the soccer kicking performance for distance among different groups have been shown in Table 3. The mean of kicking performance for distance has been obtained in all the three groups after adjusting for the covariate. These values are different from that of the unadjusted values shown in Table 1. The advantage of using the ANCOVA is that the differences in the post testing means are compensated for the initial differences in the scores. In other words, it may be said that the effect of covariate is eliminated in comparing the effectiveness of treatments on the dependent variable.

**TABLE 3****ADJUSTED MEAN AND STANDARD ERROR OF PLYOMETRIC TRAINING, CORE TRAINING AND CONTROL GROUP IN POST TESTING**

Groups	Mean	Std. Error
Plyometric Training	45.843	.550
Combined Training	47.813	.552
Control Group	41.743	.550

Table 3 indicates adjusted mean and standard error of plyometric training group  $45.843 \pm .550$ , combined training group  $47.813 \pm .594$  and control group  $41.743 \pm .550$ .

**TABLE 4**  
**ANCOVA TABLE FOR THE DATA ON SOCCER KICKING PERFORMANCE FOR DISTANCE**

Source	Type III Sum of Squares	df	Mean Square	F	p-value
Pre	218.700	1	218.700	72.621	.000
Groups	190.044	2	95.022	31.553	.000
Error	78.300	26	3.012		
Corrected Total	531.467	29			

Table 4 shows the f- value for comparing the adjusted means of the three groups (plyometrics training, combined training and control group) during post testing. Since p-value of statistics is 0.00 which is less than 0.05, it is significant. Thus the null hypothesis of no difference among the adjusted post means of the data on kicking performance for distance in all groups may be rejected at 5% level.

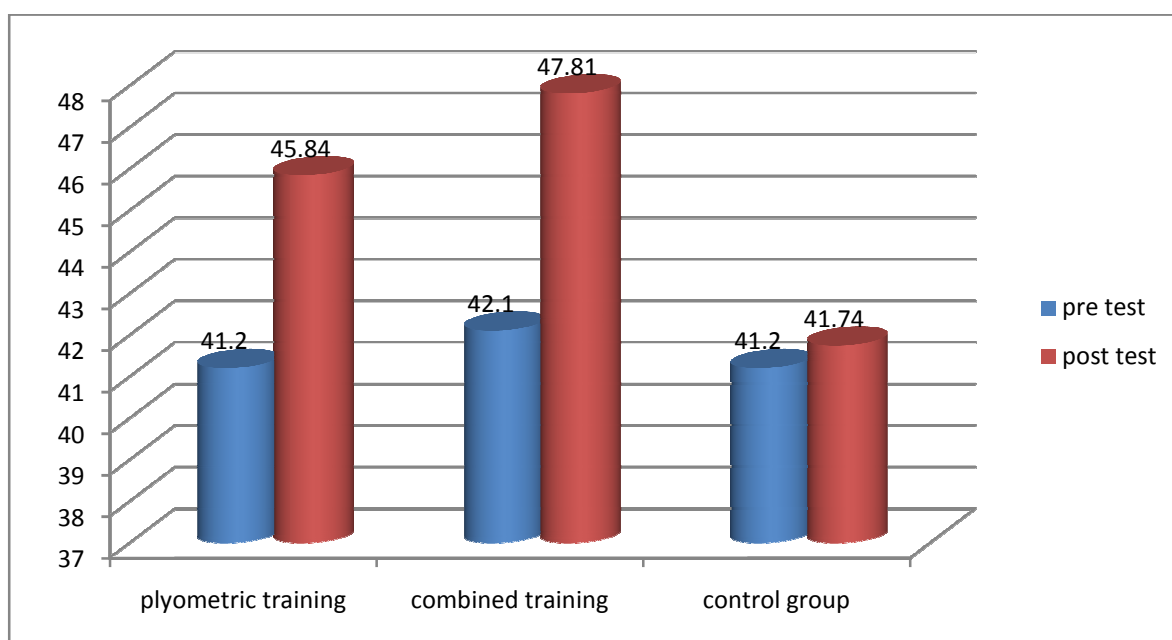
**TABLE 5****POST HOC COMPARISON OF ADJUSTED MEANS ON SOCCER KICKING PERFORMANCE FOR DISTANCE OBTAINED IN POST HOC MEASUREMENT**

(I) groups	(J) groups	Mean Difference (I-J)	Std. Error	p-value
plyometric training	combined training	1.970*	.781	.018
	control group	4.100*	.776	.000

combined training	plyometric training	-1.970*	.781	.018
	control group	6.070*	.781	.000
control group	plyometric training	-4.100*	.776	.000
	combined training	-6.070*	.781	.000

**\*significant difference at 0.05 level**

Since f – statistics is significant, post hoc comparison has been made for the adjusted means of three groups which is shown in table 5. It may be noted here that p-value for mean difference between plyometric training and control group is 0.000 and combined training and control group is 0.000. Both these p-values are less than 0.05 and hence they are significant at 5% level. Also significant difference was found in plyometric training and combined training because the p-value associated with mean difference 0.018 which is less than 0.05.



**Fig.1 Graphical representation of pre test scores and post test score of soccer kicking performance for distance**

**Discussion and findings**

From above results it is found that there is significant difference between the adjusted means of plyometric training and control group on the data on soccer kicking performance for distance during post testing also there is significant difference between adjusted means of combined training and control group on data on soccer kicking performance for distance during post testing, also significant difference was found between the adjusted means of plyometric training and combined training on data on soccer kicking performance for distance during post testing. Thus it may be concluded that soccer kicking performance for distance of the plyometric training and combined training differ and is significantly less than that of control group, hence it may be inferred that combined training (combination of plyometric and core exercises) is most effective in improving soccer kicking performance for distance.

Plyometric training is also effective in improving soccer kicking performance for distance among subjects in comparison to that of control group.

Results from several investigations involving adults suggest that combining plyometric training with resistance training may be useful for enhancing muscular performance (Adams et al., 1992; Fatouros et al., 2000). For example, Fatouros and colleagues (2000) reported that after 12 weeks of training adult subjects who combined plyometric training with resistance training increased vertical jump performance by 15% whereas gains of 11% and 9% were reported for subjects who performed only resistance training or plyometric training, respectively. Similar findings were recently reported by Myer and colleagues (2005) who observed that a six week, multi-component training program which included resistance training, plyometric training and speed training significantly enhanced strength, jumping ability and speed in female adolescent athletes as compared to a nonexercising control group. In the aforementioned study (Myer et al, 2005), it is unknown which training component was most effective or whether the effects were combinatorial.

Kicking performance has been related to leg muscle strength (De Proft et al. 1988; Dutta and Subramaniam 2002; Jelusic et al. 1992; Manolopoulos et al. 2004). De Proft et al. (1988) noted that after a specific leg strength training program during a full football season the concentric strength of the knee increased and kick performance (measured as kicking distance) improved (De Proft et al. 1988). They also reported that the correlations between leg strength and kick performance improved from the beginning to the end of the season in adolescent football players. In the present investigation, kicking performance was improved with plyometric training and core training. In general, kick performance has been determined by measuring the distance reached by the ball after kicking (De Proft et al. 1988), or by the velocity of the ball after it has been hit (Aagaard et al. 1996; Trolle et al. 1993). In theory, the velocity of the ball may vary depending on the characteristics of the ball and the technique of kicking. In addition to these factors, the kicking distance depends also on the take-off angle of the ball, wind direction, air density (altitude), and the amount of imparted spin. Thus, to better isolate the effect of the strength-training program on the capacity to kick the ball harder, we measured the angular speed of the knee, which is the main factor determining the velocity of the ball (Dorge et al. 1999; Lees and Nolan 2002).

## REFERENCES

- Aagaard, P., Simonsen, E.B., Trolle, M., Bangsbo, J., and Klausen, K. 1996. Specificity of training velocity and training load on gains in isokinetic knee joint strength. *Acta Physiol. Scand.* **156**: 123–129. doi:10.1046/j.1365-201X.1996.438162000.x. PMID:8868268.
- Agaoglu SA, Kaldirimci M, Tasmektepligil Y 2000. Agirlik topuyla yapilan plyometric antrenmanin hentbolcularin dikey sicramasi ve atis kuvvetine etkisi. *Gazi University Beden Egitimi ye Spor Bilimleri 1. Kongresi Bildiri Kitabi*, pp. 58-66.
- Baechle, T.R., R.W. Earle, 2000. *Essentials of Strength Training and Conditioning*. 2nd Edition. Champaign, IL: National Strength And Conditioning Association.

- Behrens M, Mau-Moeller A, Bruhn S 2014. Effect of plyometric training on neural and mechanical properties of the knee extensor muscles. *J Electromyogr Kines*, 24(1): 98-103.
- Campo, S., Vaeyens, R., M. Philippaerts, Carlos Redondo, J., Ana Mari´A De Benito and Cuadrado, G., 2009. Effects of lower-limb plyometric training on body composition, explosive strength, and kicking speed in female soccer players, *Journal of Strength and Conditioning Research*, Volume 23 Number 6 September ,23(6)/1714–1722
- Chimera, J., A. Swanik, B. Swanik, J. Straub, 2004. Effects of plyometric training on muscleactivation strategies and performance in female athletes. *J Athl Training.*, 39: 24-31.
- Chu DA 1992. *Jumping into Plyometrics*. Illinois: Leisure Press Champaign.
- Chu, D.A., 1998. *Jumping into plyometrics*, 2nd edition. Human Kinetics, Champaign, IL.
- De Proft, E., Cabri, J., Dufour, W., and Clarys, J.P. 1988. Strength training and kick performance in soccer players. *In Science and Football. Edited by T. Reilly, A. Lees, K. Davids, and W.J. Murphy.* E FN Spon., London, UK. pp. 108–113.
- Dorge, H.C., Andersen, T.B., Sorensen, H., Simonsen, E.B., Aagaard, H., Dyhre-Poulsen, P., et al. 1999. EMG activity of the iliopsoas muscle and leg kinetics during the soccer place kick. *Scand. J. Med. Sci. Sports*, 9: 195–200. PMID:10407926
- Dutta, P., and Subramaniam, S. 2002. Effect of six weeks of isokinetic strength training combined with skill training of football kicking performance. *In Science and football IV. Edited by W. Spinks, T. Reilly, and A. Murphy.* Taylor and Francis, London, UK. pp. 333–340.
- Fahey T, Insel P, Roth W 2011. *Fit and Well: Core Concepts and Labs in Physical Fitness and Wellness*. 9th Edition. Canada: Active, Softcover.
- Hoare, G., R. Warr, 2000. Talent identification and women’s soccer: an Australian experience. *J Sports Sci.*, 18: 751– 758.
- Jelusic, V., Jaric, S., and Kukolj, M. 1992. Effects of the stretchshortening strength training on kicking performance in soccer players. *J. Hum. Mov. Stud.* 22: 231–238.
- Kim, H. Y. (2012). “Effects of plyometric training on ankle joint motion and jump performance.” *Korean Journal of Sports Medicine.* 30: 47–54.
- Krustrup, P., M. Mohr, H. Ellingsgaard, J. Bangsbo, 2005. Physical demands during an elite female soccer game: importance of training status. *Med Sci Sports Exerc.*, 37: 1242–1248.
- Stolen, T., K. Chamari, C. Castagna, U. Wisloff, 2005. Physiology of soccer: an update. *J Sports Med.*, 35: 501– 536.
- Lee, C.S. & Choi, S. N. (2005). “The effects of 12 weeks plyometric training on the muscular functions of lower extremities of jumpers.” *Korea Sport Research.*16: 897–908.



- Lees, A., and Nolan, L. 2002. Three dimensional kinematics analysis of the instep kick under speed and accuracy conditions. *In Science and football IV. Edited by W. Spinks, T. Reilly, and A. Murphy.* Taylor and Francis, London, UK. pp. 16–21.
- Manolopoulos, E., Papadopoulos, C., Salonikidis, K., Katartzi, E., and Poluha, S. 2004. Strength training effects on physical conditioning and instep kick kinematics in young amateur soccer players during preseason. *Percept. Mot. Skills*, **99**: 701–710. PMID:15560363.
- Park, J. H. (2000). “The Effect of short term Plyometric & Isotonic Training on Power Abilities.” Graduate School Chosun University. 15–18.
- Pienaa C, Coetzee B 2013. Changes in selected physical, motor performance and anthropometric components of university-level rugby players after one microcycle of a combined rugby conditioning and plyometric training program. *J Strength Cond Res*, *27*(2): 398-415.
- Piirainen JM, Cronin NJ, Avela J, Linnamo V 2014. Effects of plyometric and pneumatic explosive strength training on neuromuscular function and dynamic balance control in 60-70 year old males. *Italian Journal of Anatomy and Embryology*, *119*(1): 10-19.
- Potdevin FJ, Alberty ME, Chevutschi A, Pelayo P, Sidney MC 2011. Effects of a 6-week plyometric training program on performances in pubescent swimmers. *J Strength Cond Res*, *25*(1): 80-86
- Qianyun S, Fang G, Jingguo Z 2013. Efforts of core strength training on the event related potentials P300 in college students. *Contemporary Sports Technology*, *17*: 14.
- Stane, M.L., M.E. Powers, 2005. The Effects of Plyometric Training on Selected Measures of Leg Strength and Power when Compared to Weight Training and Combination Weight and Plyometric Training. *J Athl Train*, *42*(3): 186-92.
- Thomas, R., 2003. Science and soccer, 2nd edition, *Taylor & Francis Group*; Liverpool, UK. Pp. 405.
- Trolle, M., Aagaard, P., Simonsen, E.B., Bangsbo, J., and Klausen, K. 1993. Effects of strength training on kicking performance in soccer. *In Science and football II. Edited by T. Reilly, J. Clarys, and A. Stibbe.* E FN Spon, London, UK. pp. 95–98.
- Weston M, Coleman NJ, Spears IR 2013. The effect of isolated core training on selected measures of golf swing performance. *Med Sci Sport Exer*, *45*(12): 2292-2297.
- Yang, J.H., Park, C.U. & Choi, J.H. (2007). “Effect of 24-week weight training and plyometric training on the physique, body composition and fitness of male high school students.” *Journal of Sport Leis Stud.* *30*: 583–593.