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## RESEARCH ARTICLE

# EFFECT OF PLYOMETRIC TRAINING ON VARIOUS SURFACE ON SELECTED PHYSICAL FITNESS VARIABLES AMONG COLLEGE WOMEN SOCCER PLAYERS

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### ABSTRACT

The purpose of the study was to examine the effect of plyometric training on various surface on selected physical fitness variable among college women soccer players. To achieve the purpose 36 inter- collegiate women soccer players were selected as subjects. Their age ranged between 18 and 24. The selected subjects were randomly segregated into four groups of nine each. Group-I underwent plyometric exercises on the sand surface, group-II underwent plyometric exercises on the soil surface, group-III underwent plyometric exercises on the grass surface and group-IV acted as control. The investigator has selected speed, agility and endurance as physical fitness variables. The experimental variable used in the study was plyometric training on various surface (Sand, Soil and Grass). A 12-week plyometric training programme was developed using three training sessions per week. The results show that, 12 weeks of sand, soil and grass surface plyometric training improved the speed, agility and endurance performance significantly. Considering the endurance, performance, sand surface plyometric training is better than soil and grass surface plyometric training. However, when comparing soil and grass surface plyometric training groups, soil surface is better than grass surface.

## INTRODUCTION

Soccer (also known as football) is the world's most popular form of sport, being played in every nation without exception. Female's soccer is one of today's most popular sports, yet not so long ago, females were forbidden to play it. In fact, until fairly recently, it was still a male-dominated game. The popularity of women's soccer continues to grow as evidenced by the six to eight million female athletes between the ages of 6 and 24 years playing soccer. 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). Plyometric training has many advantages for the improvement of athlete's overall performance in various sport events including soccer. Plyometric training exercise improve explosive power, muscular strength, speed and quickness, agility, neuromuscular coordination, vertical jump performance, leg strength, muscular power, increase joint awareness and enhance soccer skill performances of the athletes.

Plyometric training is widely used in conditioning, power training and in prevention and rehabilitation of injuries in some sports (Roopchand-Martin & LueChin, 2010). In the majority of sports, Plyometric Training can cause improvement in athletic performance parameters, such as speed, agility, and power. However, many individual and environmental factors affect the performance of athletes in plyometric training. Many researchers have indicated that the level of effect on athletic performance in Plyometric training is influenced by the amount of energy returned to the athlete from the training surfaces, depending on the stiffness of the surface (Arazi & Asadi, 2011; Impellizzeri et al., 2008). The recoil energy of the training surface together with the stretch-reflex cycle in Plyometric training affects the training efficiency. Therefore, the type of training surface plays an essential role in the effect of Plyometric training through the stretch-reflex mechanism.

## METHODOLOGY

The purpose of the study was to examine the effect of plyometric training on various surface on physical fitness

To achieve these purpose 36 inter-collegiate women soccer players were selected as subjects. Their age ranged between 18 and 24. The selected subjects were randomly segregated into four groups of nine each. Group-I underwent plyometric exercises on the sand surface, group-II underwent plyometric exercises on the soil surface, group-III underwent plyometric exercises on the grass surface and group-IV acted as control. The investigator has selected speed, agility and endurance as physical fitness variables. The experimental variable used in the present study was plyometric training in various surface (Sand, Soil and Grass).

### TRAINING PROGRAMME

The training programmes were scheduled for one session a day. Each session lasted for one hour to one and half hour approximately including warming up and warming down. During the training period, the experimental groups underwent their respective training programme three days a week on alternative days for twelve weeks in addition to their regular programme. The group-I performed plyometric training in sand surface, group-II did plyometric training in soil surface and group - III underwent plyometric training in grass surface. A 12-week plyometric training programme was developed based on the recommendations of intensity and volume by Piper and Erdmann, (1998). Training volume ranged from 70 foot contacts to 120 foot contacts per session. The rest interval of 1:1 ratio between repetitions and 1:5 ratio between sets was provided.

### STATISTICAL TECHNIQUE

Analysis of covariance (ANCOVA) was used as a statistical technique to find out the significant difference if any. Whenever the obtained 'F' ratio for adjusted post test means was found to be significant, the Scheffe'S test was applied as post hoc test to determine the paired mean differences (Broota, 1989). In all the cases level of confidence was fixed at 0.05 for significance.

### RESULTS OF THE STUDY

The pre & post test data collected on speed, agility and endurance were analysed statistically and descriptive statistics on speed, agility and endurance were presented in level-I.

## RESULTS

The obtained paired 't' test results proved that, the mean difference found between pre and post data of sand, soil and grass surface plyometric training group's differ significantly, as the paired 't' values 5.41, 5.67 & 5.52 of sand, soil and grass surface plyometric training group's are more than the table value of 2.31 required for significance. The obtained paired 't' test results proved that, the mean difference found between pre and post test data on agility of sand, soil and grass surface plyometric training group's differ significantly, as the paired 't' values (3.15, 4.20 & 12.92) of sand, soil and grass surface plyometric training group's are more than the table value 2.31 required for significance. The obtained paired 't' test results proved that, the mean difference found between pre and post data on endurance of sand, soil and grass surface plyometric training group's differ significantly, as the paired 't' values (10.26,

4.42 & 5.75) of sand, soil and grass surface plyometric training group's are more than the table value 2.31 required for significance. The obtained ANCOVA statistic results on speed, agility and endurance performance of different surface plyometric training group and control group are presented in table – 2. The obtained 'f' ratio values 49.37, 40.80, 92.51 and 6.77 through ANCOVA statistics proved that, the adjusted post test mean values 8.92, 8.94, 8.98 and 11.13 on speed, the adjusted post test mean values 10.65, 10.99, 11.06 and 12.69 on agility, the adjusted post test mean values 2121.00, 1893.00, 1567.00 and 1141 on endurance training and control groups differ from one another. Because the obtained 'F' value of speed, agility and endurance respectively 49.37, 40.80 and 92.51 and 6.77 are better than the table value of 2.91 required for significance for degrees of freedom 3 and 31. The Scheffe's Test results on speed, agility and endurance performance of different surface plyometric training groups and control group are presented in table 3. It proved that as a result of sand, soil and grass surface plyometric training the speed performance improved significantly, because the mean difference of 2.21, 2.19 and 2.15 are more than the confidence interval value of 0.62. While comparing experimental groups, insignificant differences were observed between sand, soil and grass surface plyometric training groups in improving the speed performance. It proved that as a result of sand, soil and grass surface plyometric training the agility performance improved significantly, because the mean difference of 0.64, 0.95 and 0.75 are more than the confidence interval value of 0.25. While comparing experimental groups, insignificant differences were observed between sand, soil and grass surface plyometric training groups in improving the agility performance. It proved that as a result of sand, soil and grass surface plyometric training the endurance performance improved significantly, because the mean difference of 980.00, 752.00 and 426.00 are more than the confidence interval value of 184.38. Although, sand surface plyometric training is better than soil and grass surface plyometric training however, when comparing soil and grass surface plyometric training groups, soil surface is better than grass surface.

## DISCUSSION

The results showed that, 12 weeks of sand, soil and grass surface plyometric training improved speed, agility and endurance performance significantly. Significant differences were observed between sand soil & grass surface plyometric training groups in improving the speed and agility performance. Considering the endurance performance, sand surface plyometric training is better than soil and grass surface plyometric training however, when comparing soil and grass surface plyometric training groups, soil surface is better than grass surface. some of the supportive studies are given below: Muhammad Hazman bin Shamshuddin *et al.* (2020), conducted a study that aimed to evaluate the effects of 6-weeks plyometric training on speed and agility performance among recreational football players. And they have concluded that intervention group had significant improvement in sprint time before and after weeks of training ( $t = 3.76$ ,  $p = 0.001$ ) when compared to the control group. The agility performance of the intervention group also showed a significant difference when compared to the control group. Granacheri. U *et al.* (2015), investigated the effects of plyometric training on stable (SPT) vs. highly unstable surfaces (IPT) on athletic performance in adolescent soccer players.

**Table 1. Descriptive Statistics on Speed, Agility and Endurance of Different Surface Plyometric Training and Control Groups**

Variables	Group	Test	N	Mean	SD	DM	't' -ratio
Speed	Sand Surface Plyometric Training	Pre	9	9.73	0.46	0.79	5.41*
		Post		8.94	0.35		
	Soil Surface Plyometric Training	Pre	9	9.81	0.40	0.85	5.67*
		Post		8.96	0.39		
	Grass Surface Plyometric Training	Pre	9	9.82	0.52	0.82	5.52*
		Post		9.00	0.40		
Control(CG)	Pre	9	11.03	0.68	0.04	0.98	
	Post		11.07	0.63			
Agility	Sand Surface Plyometric Training	Pre	9	11.71	0.84	1.09	3.15*
		Post		10.62	0.41		
	Soil Surface Plyometric Training	Pre	9	11.74	0.56	0.78	4.20*
		Post		10.96	0.24		
	Grass Surface Plyometric Training	Pre	9	12.04	0.28	0.95	12.92*
		Post		11.09	0.11		
Control(CG)	Pre	9	12.08	0.50	0.65	4.33*	
	Post		12.72	0.69			
Endurance	Sand Surface Plyometric Training	Pre	9	1461.10	126.93	661.10	10.26*
		Post		2122.20	130.17		
	Soil Surface Plyometric Training	Pre	9	1455.60	287.71	438.80	4.42*
		Post		1894.40	80.79		
	Grass Surface Plyometric Training	Pre	9	1177.80	44.10	383.30	5.75*
		Post		1561.10	183.33		
Control(CG)	Pre	9	1566.70	180.28	422.22	7.46*	
	Post		1144.40	104.42			

Table value required for df 8 is 2.31 (\*significant at 0.05 level)

**Table 2. ANCOVA Results on Speed, Agility and Endurance of Different Surface Plyometric Training and Control Groups**

Variables	Mean	Sand Surface Plyometric Training	Soil Surface Plyometric Training	Grass Surface Plyometric Training	Control	S o V	SS	df	MS	F'ratio
						B	W	B	W	
Speed	Adjusted post test	8.92	8.94	8.98	11.13	B	22.49	3	9.83	49.37*
						W	6.17	31	0.20	
Agility	Adjusted post test	10.65	10.99	11.06	12.69	B	21.54	3	7.18	40.80*
						W	5.45	31	0.18	
Endurance	Adjusted post test	2121.00	1893.00	1567.00	1141	B	4863384.67	3	1621128.2 2	92.51*
						W	543249.71	31	17524.18	

(Table value required for significant for df 3&31 is 2.91) \*Significant (.05 level)

**Table 3. Scheffe's Test on Speed, Agility and Endurance of Different Surface Plyometric Training and Control Groups**

Variables	Sand Surface Plyometric Training	Soil Surface Plyometric Training	Grass Surface Plyometric Training	Control	MD	CI
Speed	8.92	8.94	8.98	11.13	0.02	0.62
	8.92				0.06	0.62
	8.92	8.94	8.98	11.13	2.21*	0.62
					0.04	0.62
		8.94		11.13	2.19*	0.62
			8.98	11.13	2.15*	0.62
Agility	10.65	10.99	11.06	12.69	0.34	0.59
	10.65				0.41	0.59
	10.65	10.99	11.06	12.69	2.04*	0.59
					0.07	0.59
		10.99		12.69	1.70*	0.59
			11.06	12.69	1.63*	0.59
Endurance	2121.00	1893.00	1567.00	1141.00	228.00*	184.38
	2121.00				554.00*	184.38
	2121.00	1893.00	1567.00	1141.00	980.00*	184.38
					326.00*	184.38
		1893.00		1141.00	752.00*	184.38
			1567.00	1141.00	426.00*	184.38

\*Significant at .05 level

And they observed that, following 8 weeks of training, similar improvements, agility and balance were observed in the IPT and SPT groups. However, the performance of IPT appears to be less effective for increasing Counter Movement Jump height compared to SPT. Ramírez-Campillo *et al* (2015) compared the effects of 6 weeks of vertical, horizontal, or combined vertical and horizontal plyometric training on muscle explosive, strength endurance, and balance performance. And they have concluded that vertical, horizontal, and combined vertical and horizontal jumps induced meaningful improvement in explosive actions, balance, and intermittent endurance capacity. However, combining vertical and horizontal drills seems more advantageous to induce greater performance improvements.

## CONCLUSION

Based on the results, the following conclusions were drawn:

**Speed:** Due to 12 weeks of plyometric training the speed performance of college women soccer players improved significantly in sand, soil and grass surfaces.

**Agility:** As a result of plyometric training, the agility performance of college women soccer players improved significantly in sand, soil and grass surfaces.

**Endurance:** Plyometric training protocols considerably enhanced the endurance performance of college women soccer players significantly in sand, soil and grass surfaces. Although, sand surface plyometric training is better than the soil and grass surface plyometric training. When comparing soil and grass surface plyometric training groups, soil surface is better than grass surface.

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