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The Efficacy of Sand and Grass Plyometric Training on Agility, Cardiovascular Endurance, Explosive Power and Speed in Football Players

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Abstract:
Background and Introduction: *The purpose of this study was to compare the effects of a 6-week plyometric training on two different surfaces, sand and grass on selected physical fitness variables namely; agility, cardiovascular endurance, explosive power and speed in interuniversity level football players. These physical fitness variables are prerequisite of football player which can be enhanced by plyometric training. The plyometric training are exercises that are designed to enhance neuromuscular performance. Due to the powerful eccentric forces during the decelerating/landing phases, and rapid transition to the concentric propulsive phase, plyometric training can also constitute an effective training stimulus to reduce lower-extremity injuries in team sports. The plyometric exercises can be performed on different surfaces and each surface may prove different training stimulus as resistance of each surface is different.* ***Methodology:*** *This comparative and experimental study included sample of 40 male interuniversity players aged 18 to 25 years, which were randomly divided into two groups- sand training group (N=20) and grass training group (N=20). After the baseline measurements of variables plyometric training was given for 6-weeks, three sessions per week for both the groups.* ***Results:*** *Data when compared after plyometric training revealed there was significant increase in performance of the players in both the groups ($p \leq 0.05$). Moreover, on comparing both the groups, sand group showed more improvement in cardiovascular endurance, explosive power and speed than grass plyometric group. While there was no significant difference between the two groups in context with agility.* ***Conclusion:*** *This study concluded that both the surfaces are able to enhance the performance of football players. While comparing the groups sand surface plyometric training was found more effective than grass surface training in reference with cardiovascular endurance, explosive power and speed while agility was equally improved in both the groups. Thus both the surfaces can be used as an alternative to increase agility.*

Keywords: *Plyometric Training, Sand surface, Grass surface, Cardiovascular Endurance*

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I. Introduction

Football is a sport demanding high-intensity, intermittent, non-continuous exercise that includes sudden change of directions, several explosive ballistic motions, several sprints of different durations, quick accelerations and jumping, among other players (Khorasani *et al.*, 2010). The game requires other intense actions such as decelerations, kicking, dribbling, and tackling (Sohnlein *et al.*, 2014). Footballers need a high fitness level to survive with the physical demands of the game. Each player wants to give his best on the field according to their fitness level. Therefore, within the fitness training it takes a lot of effort to improve agility, cardiovascular

endurance, explosive power and speed of the players **(**Milenkovic, 2013). Agility is an important motor ability in majority of the sportive activities, chiefly in football. It is the ability to change direction (Taheri *et al.*, 2014). Improving agility is an essential part to increase the performance of players in football (Sporis *et al.*, 2010). Along with agility the football players have to jump over the players to fetch the ball. Explosive power is one's ability to produce maximum muscular force in shortest time. Cardiovascular endurance is defined as ability of heart and lung to take in and to transport adequate amount of oxygen to the working muscles for activities. As the game comprises of two sets of 45 minutes it requires the player to have more cardiovascular endurance. Speed refers to one's ability to perform successive movements of the same pattern at the fast rate

(Kansal, 2008). Speed is of great importance in this sport, which comprise direction and acceleration change and leaping.

Now a days, Physiotherapists and trainers use different types of training protocols for strengthening and conditioning of the players to make them more dynamic towards the game. The plyometric is one of the training protocol used by some of the Physiotherapists to improve the performance and efficiency of the players. Plyometric training involves a repeated successions of bouts, each containing a rapid deceleration of the body, followed immediately by a brief amortization phase and rapid acceleration in the opposite direction. This rapid combination of eccentric and concentric muscular activity involves the Stretch-Shortening Cycle, which is a physiological advantage to the muscles (Mirzaei *et al.*, 2014). Plyometric training is commonly performed on firm surfaces (e.g. grass and wood), but a more recent study has shown that drop jumps on sand induce less muscle damage when compared to a firm surface. However, as compared to grass surface training, sand training is a simple, low-impact form of resistance training as it delivers resistance that challenges muscles, aiding to make them faster and more explosive (Kumar 2015).

The impairment in any one of physical fitness variables may reflect to decrease the performance of the player and also makes the player more susceptible to injury. Many studies have been done on plyometric in different surfaces including sand and grass. Some literatures are in favor of grass surface training and proves positive effect in increasing athlete performance while on the other side some literatures prove sand surface superior as it gives more resistance. So there was need to investigate and compare the effect of sand and grass surfaces plyometric training in addition to their effect on agility, cardiovascular endurance, explosive power and speed in football player. Hence the present study was conducted to address the physical fitness variables through plyometric training on two different training surfaces, sand and grass with the view to help football players achieve good performance during the game.

II. Material and methods

The study was experimental and comparative in nature in which 40 male interuniversity football players (aged 18-25) of Punjabi University were included. They were equally divided into two groups: Grass plyometric group (n=20) and Sand plyometric group (n=20). The Mean Age, Weight, Height and BMI for sand group was 19.2 ± 1.70, 71.19 ± 3.21, 1.73± 0.04, 23.81±0.73 and for grass group was 20.35± 2.00, 70.16± 4.25, 1.73 ±0.04, 23.45±0.56, respectively. Figure 1 presents the demographic characteristics of interventional groups.

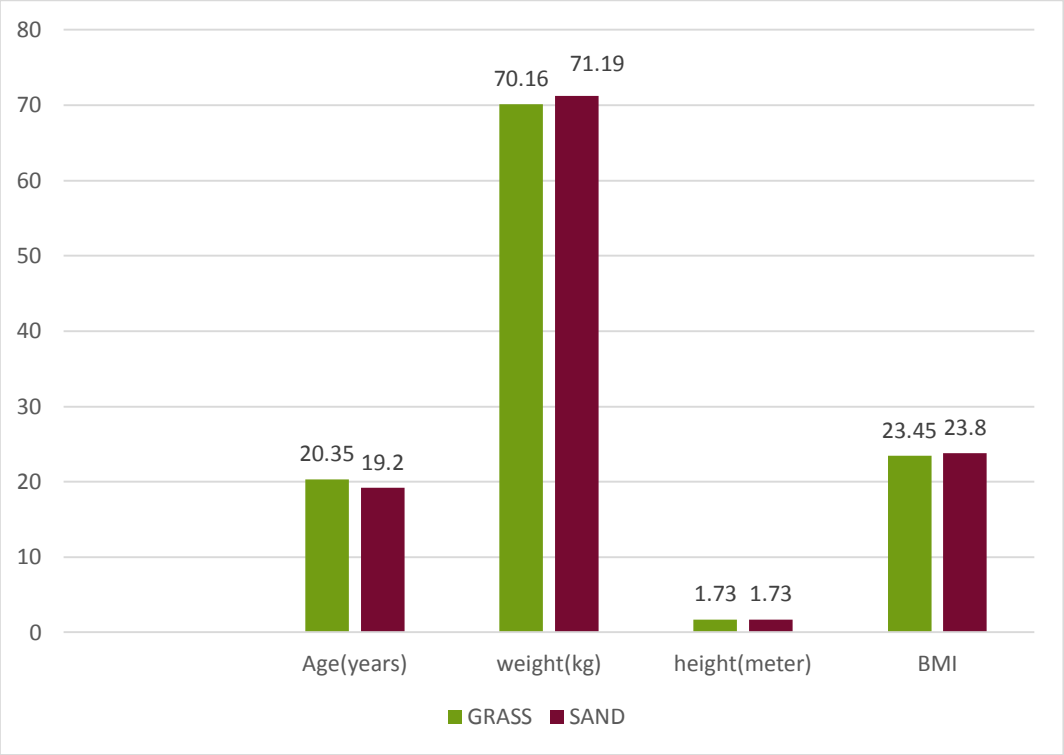

Figure 1: Demographic features of Interventional Groups

III. Tools for Data Collection

1. Dodging Run test – For assessing agility of football players.
2. Queens College step test- For assessing cardiovascular endurance of the players.

3. Vertical Jump test- For assessing explosive power of lower limbs.
4. 50-meter Sprint test- For assessing speed of football players.

After taking pre-training data from subjects of both the groups, they were given sand and grass plyometric training protocol for 3 sessions per week for 6 weeks. Post training data was obtained from all the subjects after completion of 18 sessions of plyometric training protocol. The protocol consisted of Side to side ankle hops, Standing jump and reach, Front cone hops, standing long jump, Lateral jump over barrier, Double leg hops, Diagonal cone hops, standing long jump with lateral sprint, Single leg bounding, Lateral jump single leg, Hexagon drill, Cone hops with change of direction sprint (Sozbir, 2016).

IV. Results

The data was analysed with the help of Microsoft excel software. Paired t test was used to find the comparison of sand and grass plyometric groups for agility, cardiovascular endurance, explosive power and speed at Significance level ≤0.05.

Table 1 presents comparison of mean score of Pre Training and Post Training observations of physical fitness variables in Sand Plyometric Group. t value suggests that there is statistically significant improvement in Agility (t=4.64), Cardiovascular Endurance (t=4.60) Explosive Power (t=6.21) and Speed (t=4.69) of football players.

Parameter	Phase	Sand Plyometric Group Mean ± SD	t value
Agility (seconds)	Pre	16.95 ± 0.84	4.64*
	Post	16.49 ± 0.70	
Cardiovascular Endurance	Pre	58.368 ± 5.55	4.60*
	Post	62.988 ± 4.85	
Explosive Power (inches)	Pre	17.5 ± 1.79	6.21*
	Post	19.95 ± 1.79	
Speed (seconds)	Pre	6.78 ± 0.39	4.69*
	Post	6.49 ± 0.28	

Table 1: Comparison of pre and post training observations of physical fitness variables in Sand Plyometric Group

* Statistical significance at p≤0.05, df= 19

Table 2 presents comparison of mean score of Pre Training and Post Training observations of physical fitness variables in Grass Plyometric Group. t value suggests that there is statistically significant improvement in Agility (t=3.43), Cardiovascular Endurance (t=2.80), Explosive Power (t=4.35) and Speed (t=2.41).

Parameter	**Phase**	**Grass Plyometric Group Mean ± SD**	**t value**
Agility(seconds)	Pre	17.70 ± 0.90	3.43*
	Post	17.31 ± 1.04	
Cardiovascular Endurance	Pre	54.08 ± 6.36	2.80*
	Post	56.016 ± 5.63	
Explosive power (inches)	Pre	16.6 ± 2.54	4.35*
	Post	17.95 ± 2.54	
Speed(seconds)	Pre	7.28 ± 0.65	2.41*
	Post	7.14 0.70	

Table 2: Comparison of pre and post training observations of physical fitness variables in Grass Plyometric Group *Statistical significance at p≤0.05, df= 19

Table 3 presents comparison between the both the interventional groups. Statistically the t value came out to be more than the table value for Cardiovascular Endurance, Explosive Power and Speed, which shows the

significant difference between the two groups with more effect of sand surface training than the grass surface training. However, for Agility Sand Plyometric Group though registered better records when compared with Grass Plyometric Group but there is no significant difference found between the two groups as the table value is more than the calculated value at $p \leq 0.05$.

Parameter	Sand Plyometric Group			Grass Plyometric Group			t value
	Pre	Post	Difference	Pre	Post	Difference	
Agility(seconds)	16.95	16.49	0.46	17.697	17.3175	0.3795	0.53
Cardiovascular Endurance	58.368	62.988	4.62	54.08	56.016	1.936	2.17*
Explosive power(inches)	17.5	19.95	2.45	16.6	17.95	1.35	2.36*
Speed(seconds)	6.78	6.49	0.29	7.277	7.1425	0.1345	2.18*

Table 3: Magnitude of improvement in the measure of physical fitness variables between two interventional groups.* Statistical significance at ≤0.05, df =19

V. Discussion

This study was an attempt to find the efficacy of plyometric training on two different training surfaces, sand and grass on physical fitness variables of football players. The outcome measures were namely; Agility, Cardiovascular endurance, Explosive power, and Speed, of football players who participated in the study. On finding the efficacy of grass plyometric training on above mentioned variables it was observed that The comparison of pre- and post- training observations, in grass plyometric training group, showed statistically significant improvement in all the four physical fitness variables There was a statistically significant decline in mean time taken to perform 50-meter sprint test, suggesting that speed of football players was improved by 0.137 seconds, as a result of grass plyometric training. This improvement in sprint performance could be due to changes in stride length and stride frequency followed by plyometric training (Rimmer, 2000). Similar results were found in context with agility of participants which exhibited a statistically significant increase of 0.37 seconds when assessed by dodging run test. These findings are well in line with the observation made by Asadi and Arazi (2012). Increase in vertical jump performance can be explained on the basis that plyometric training increases force and tension to the muscle cords, enhances motor unit recruitment and consequently improves leg extensor muscle activity and increases the counter moment jump (Ali and Khan, 2013). Cardiovascular endurance of the participants showed significant improvement, when compared from pre to post plyometric training of 6 weeks. Suggesting that the magnitude of this training in terms of duration, intensity and frequency was sufficient to cause physiological adaptations that could lead to an enhancement in the uptake of oxygen by the exercising muscles.

Binnie *et al.* (2013), agrees with the results of current study showing a positive effect of sand plyometric training on speed of players. According to them increase in speed of players may be due to increased cadence, a greater forward trunk lean and hip range of motion, and an increased plantar flexion. Thomas *et al.* (2009), suggested that agility improvement requires rapid force development and high power output in addition to rapid switch from eccentric to concentric muscle action in leg extensor muscles and plyometric technique can increase responses to these requirements. Mirzaei and his associates (2014) also observed ~14% increase in jumping ability on completion of six weeks of sand specific jump training. Neuromuscular adaptations such as increased motor unit functioning, increased inhibition of antagonist muscles as well as activation and co-contraction of synergistic muscle may account for the improvement in jumping abilities, as observed in present study (Potteiger *et al.*, 1999; Marcovic *et al.*, 2010). Cardiovascular endurance, which exhibited statistically significant enhancement from its pre-training level (58.37) to post-training level (62.99). The results are in favour of study by Kumar (2015), in which he founded that there is increase in cardiovascular endurance fitness level of participants when trained in sand surface for ten weeks.

Sand surface plyometric training though registered better records when compared with grass surface plyometric training for agility, no statistically significant difference found between the two groups, suggesting that both the surfaces are equally effective to improve the agility in football players. The study done by Singh *et al.* (2013), on grass and sand based surface disagrees with this findings of present study regarding agility. Their study shows more improvement in agility on grass group (6.28%). Senthil (2015), found out that cardio-respiratory endurance was improved by plyometric training. However, the study done by him was not surface specific. The reason for improved cardiovascular endurance in sand plyometric group could be because of the resistance offered by sand training which requires more energy than training on stable surfaces. This increased resistance helps improve quickness and build explosive strength because the muscles experience a greater workload during training exercises thereby improving the overall cardiovascular endurance (Kumar, 2015).

VI. Conclusion

The plyometric training in both, sand as well as grass surfaces are effective in enhancing the studied physical fitness variable in football players and both the surfaces can be used as an alternative to each other for improving agility by using plyometric training. Plyometric on sand shows significant improvement on comparing with that on grass, with reference to cardiovascular endurance, explosive power and speed in football players. Sand plyometric training can be adopted by coaches and trainers as an effective training mode to enhance the performance of football players.

VII. Limitations

The result of the study was based on small sample size, so the findings cannot be generalized and care should be taken before drawing any concrete decision from the study. The factors such as socio economic status and dietary habits, which may have effect on the players were not taken into consideration. The study was carried out only on single sport discipline i.e. football focusing only on male football players.

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