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Original Research Article

Effect of Plyometric Training on Grass Versus Rubberised Floor on Selected Sports Specific Performance and Muscle Soreness in Collegiate Players

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ABSTRACT

Plyometric training is now a day commonly used by the trainers and physiotherapist to enhance the performance of the athletes. The plyometric training also called stretch shortening drills are able to increase the physical fitness variables of player that is a pre-requisite of each game. 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 as impact of each surface is different due to resistance offered by every surface is variable. The purpose of this study was to determine the effects of 6-week plyometric training on two different surfaces, grass and rubberised floor on selected physical fitness variables namely; agility, cardiovascular endurance, explosive power, speed and muscle soreness in collegiate level players. Methodology: This comparative and experimental study included sample of 40 male collegiate players aged 18 to 25 years, which were randomly divided into two groups- Grass training group (n=20) and Rubberised floor 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 changes in performance of the players in grass plyometric group as compared to rubberised floor ($p \leq 0.05$). Moreover, Grass plyometric group showed significant decline in muscle soreness every week. Conclusion: This study concluded that both the surfaces are able to enhance the performance of athlete. While comparing the groups grass surface plyometric training was found more effective than rubberised floor surface training in context enhances all fitness variables with low risk of injury to the athlete as muscle soreness in low in Grass plyometric group.

Keywords: Plyometric Training, grass surface, rubberised floor surface, muscle soreness.

INTRODUCTION

Plyometric training has been utilised by physiotherapists and coaches to enhance the physical fitness variables of athletes. Plyometric exercise activates a muscle's stretch-shortening cycle, which is created by a rapid eccentric stretch of a muscle followed by a rapid concentric contraction, producing a forceful explosive movement. During the eccentric phase, also referred to as the loading phase, the motor unit recruitment in the muscle is increased by the force of the muscle that is stretched. Once the muscle is stretched to its limit, it then contracts (concentric contraction) allowing all of the force generated to be used by the body in the form of explosive movement. The body is therefore able to produce a greater amount of force to improve an individual's performance in high power and high velocity exercises. All the sports players need to possess high-levels of motor abilities along with athletic performance to be fruitful in matches and tournaments. (Ostojic, Mazic, & Dikic, 2006). Plyometric training (PT), a training method to improve explosive leg strength in sports. Also called "jump training" or "shock movements "During a match, players demonstrate a range of physical performance characteristics for specific movement patterns such as dripping, shooting, passing, throwing, rebounding blocking) and basic movement patterns (running, jumping, change of direction). Therefore, different training models had been applied by trainers and coaches applied to players to develop their motor skills from an early age. In particular, the lower limb strength and jumping ability of players play an essential role in sports like basketball, football etc (Alemdaroğlu, 2012).

The most common form of plyometrics, known as land plyometrics, requires constant jumping and landing which exerts a large amount of force on the lower body. Plyometrics contains an eccentric and concentric movement of the muscle, which displays the stretch shortening cycle (SSC). Plyometric exercises are characterized by a high intensity stretch shortening cycle and jumps with drops from heights between twenty and eighty cms, usually performed on a rigid or flat surface. The recoil energy of the training surface along with the stretch-reflex cycle in Plyometric training affects the training efficiency. Therefore, the type of training surface plays a vigorous role in the effect of PT through the stretch-reflex mechanism (Arazi & Asadi, 2011; Impellizzeri et al., 2008).

Although plyometrics is known to enhance explosive performance in power, vertical jump and sprinting speed, an increase in injury is prevalent. With it eccentric forces, the amount of force placed on the musculoskeletal system increases the risk of injury and in some cases intensifies the level of muscle soreness. Due to the great impact and stress exerted on musculo-tendinous structures, PT must be applied with caution, adapting the load to the characteristics of the individual in all cases intensity of the jumps is found to be beneficial for the improvement of explosive strength, these training methods have been criticized for their potential to raise the appearance of injuries (Blattner et al., 1979). Due to the great impact and stress exerted on musculo-tendinous structures, Plyometric Training must be applied with caution, adapting the load to the features of the individual in all cases. Plyometrics training are performed in different surfaces such as aquatic, sand, and, wooden and grass etc. and the outcomes of the training are varying according to the surface resistance. For example, sand surface offers more resistance as compared to land, nevertheless aquatic surface imposes more resistance than sand.

As the resistance offered by different surfaces are different, the training outcomes in both the given surfaces will also be different. In the study two different surfaces i.e. grass and rubberised floor was used to train the collegiate players in order to investigate and compare the efficacy of these surfaces on different on physical fitness variable of the players.

METHODOLOGY

The study was experimental and comparative in nature in which 40 male collegiate players (aged 18-25) of Maharaj Vinayak Global University were included. They were equally divided into two groups: Grass plyometric group (n=20) and Rubberised floor plyometric group (n=20). The Mean Age, Weight, Height and BMI for grass plyometric group was 20.35± 1.92, 69.86± 4.10, 1.73± 0.04, 23.35± 0.52 and for Rubberised floor plyometric group was, 22.5±1.57, 71.35± 5.0082, 1.72± 0.0629, 24.17± 1.0551 respectively. Figure 1 and 2 presents the demographic characteristics of interventional groups.

Table 1. Demographic Data of Grass Plyometric Training Group and Rubberised Floor Plyometric Training Group

Parameters	Grass Plyometric Group	Rubberised Floor Plyometric Group
	Mean ±S.D	
Age(years)	20.35± 1.92	22.5±1.57
Weight(kg)	69.86± 4.10	71.35± 5.0082
Height(meter)	1.73± 0.04	1.72± 0.0629
BMI(Kg/m2)	23.35± 0.52	24.17± 1.0551

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.
5. Muscle soreness- Muscle soreness was assessed at the end of each training session on an Italian version of 7-point Likert scale of muscle soreness (Vicker et al., 2001). It consisted of 7 points ranging from 0-6, where 0 means complete absence of soreness and 6 indicates severe pain, restricting the ability to move.

Likert scale of muscle soreness from Vickers

0- A complete absence of soreness

1 -A light pain felt only when touched/a vague ache

2 -A moderate pain felt only when touched/a slight persistent pain

3- A light pain when walking up or down stairs

4 -A light pain when walking on a flat surface/painful

5 -A moderate pain, stiffness, or weakness when walking/very painful

6- A severe pain that limits my ability to move

After taking pre-training data from subjects of both the groups, they were given grass and rubberised floor 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).

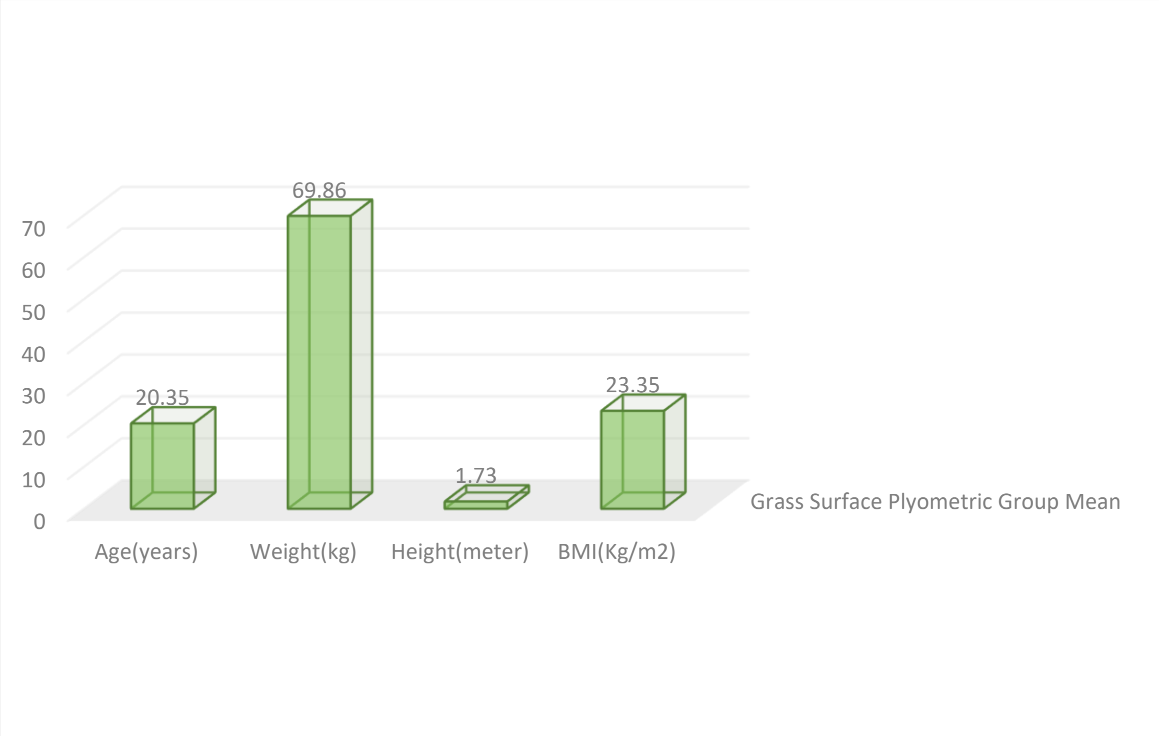

Fig 1. Demographic Data of Grass Plyometric Training Group

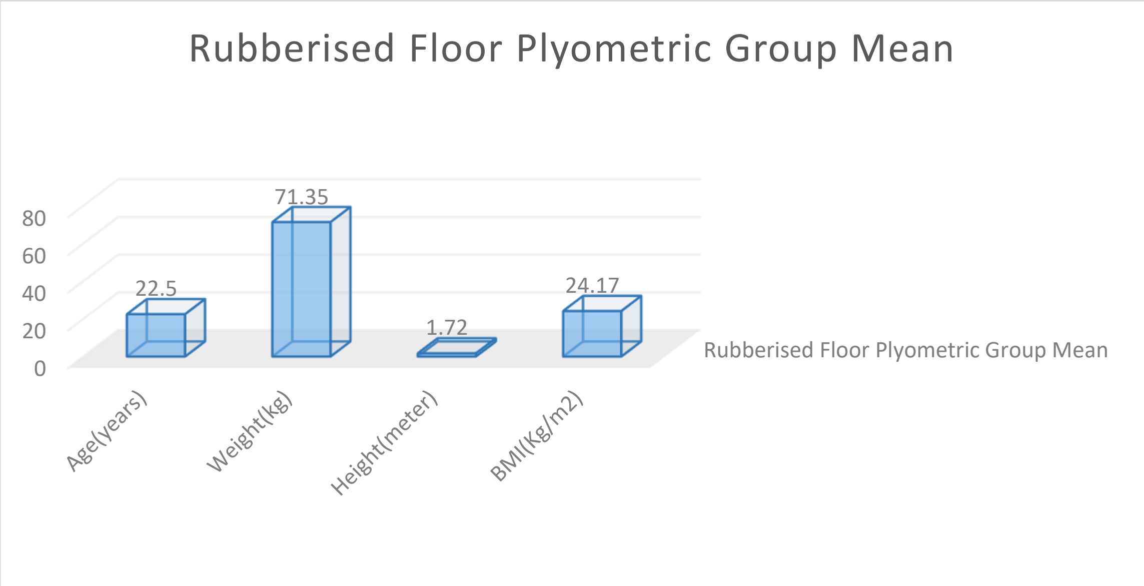

Fig 2. Demographic Data of rubberised floor Plyometric Training Group

RESULTS

The data was analysed with the help of Microsoft excel software. Paired t test was used to find the comparison of aquatic and rubberised floor plyometric groups for agility, cardiovascular endurance, explosive power and speed at Significance level $P \leq 0.05$. Pairwise Comparisons (Durbin-Conover) of muscle soreness was done to compare muscle soreness of both the surfaces.

Table 2 presents comparison of mean score of Pre Training and Post Training observations of physical fitness variables in grass Plyometric Group. P value suggests that there is statistically significant improvement in Agility (P= 0.003), Cardiovascular Endurance (P =0.011), Explosive Power (P<.001) and Speed (P=0.026) and of athletes

Parameter	Phase	Grass Surface Plyometric Group Mean ± SD	P value
Agility (seconds)	Pre	17.70±0.90	0.003*
	Post	17.32±1.04	
Cardiovascular Endurance	Pre	54.08±6.36	0.011*
	Post	56.02±5.62	
Explosive Power (inches)	Pre	16.60±2.54	< .001*
	Post	17.95±2.54	
Speed (seconds)	Pre	7.28±0.64	0.026*
	Post	7.14±0.70	

*** Statistical significance at P≤0.05, df= 19**

Table-2. Comparison of Pre and Post Training observations of Physical Fitness variables in grass Plyometric Group

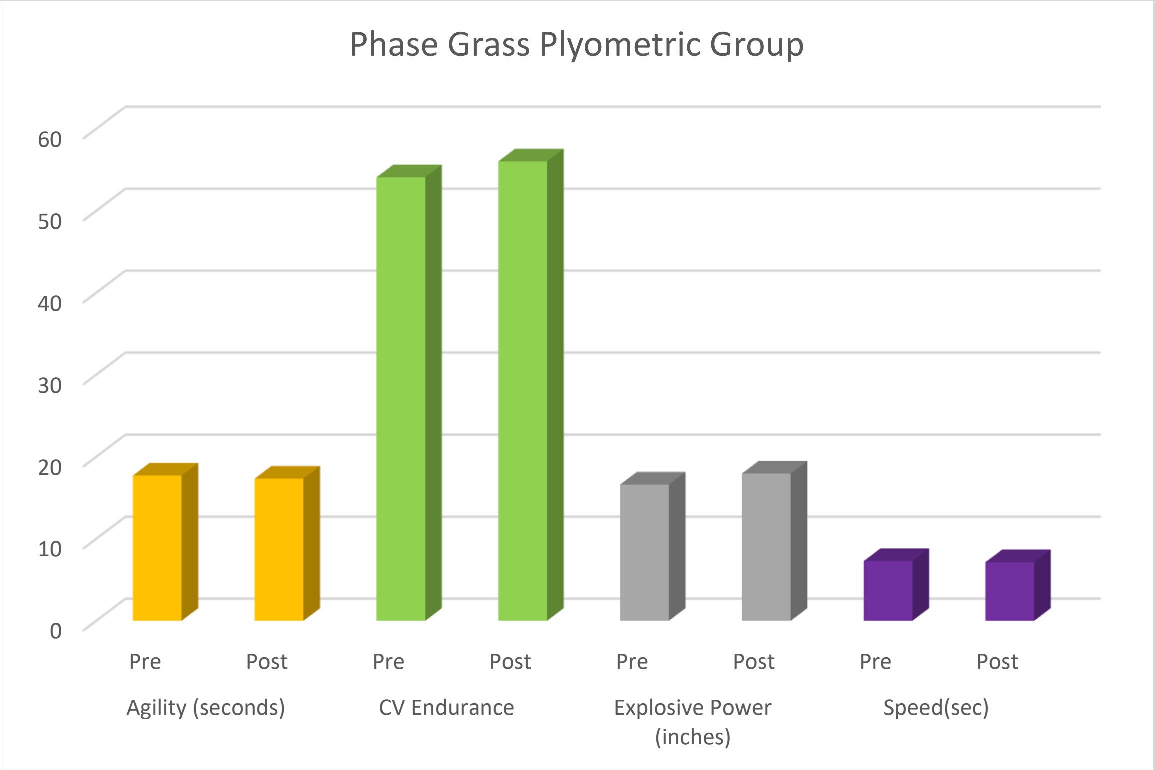

Figure -3. Level of Improvement Grass Plyometric Group

Parameter	Phase	Rubberised floor Plyometric Group Mean ± SD	P value
Agility (seconds)	Pre	17.22± 0.9	0.16
	Post	16.92±0.99	
Cardiovascular Endurance	Pre	59.02±5.58	0.30
	Post	61.58±5.91	
Explosive Power (inches)	Pre	18.61± 1.60	0.04*
	Post	18.91±2	
Speed (seconds)	Pre	7.53± 0.64	0.30
	Post	7.21± 0.59	

*** Statistical significance at p≤0.05, df= 19**

Table-3. Comparison of Pre and Post Training observations of Physical Fitness variables in Rubberised floor Plyometric Group.

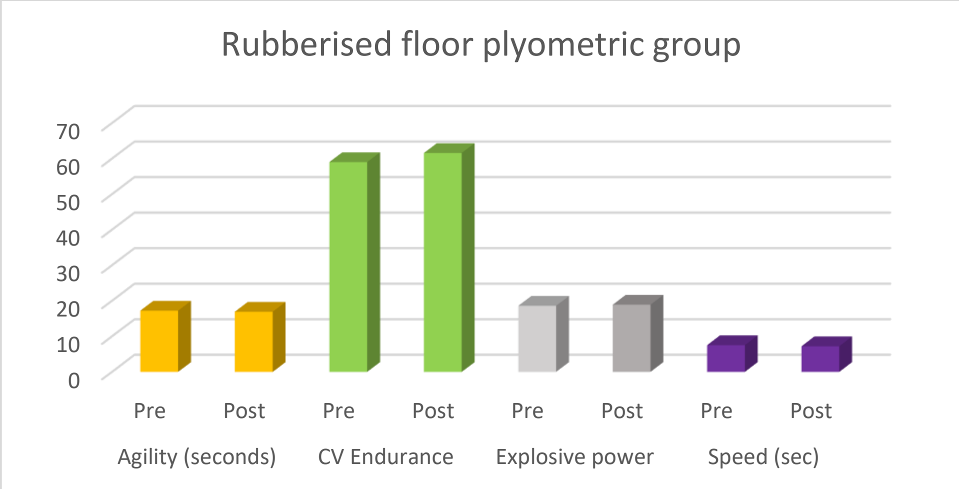

Figure -4. Level of Improvement rubberised floor Plyometric Group

Parameter	Mean grading of muscle soreness in grass group	Mean grading of muscle soreness in Rubberised floor Plyometric Group
Week 1	4.7	4.45
Week 2	3.95	4.30
Week 3	3.3	4.00
Week 4	2.6	3.05

Table- 4. 4-week comparison of muscle soreness between grass and Rubberised Floor group

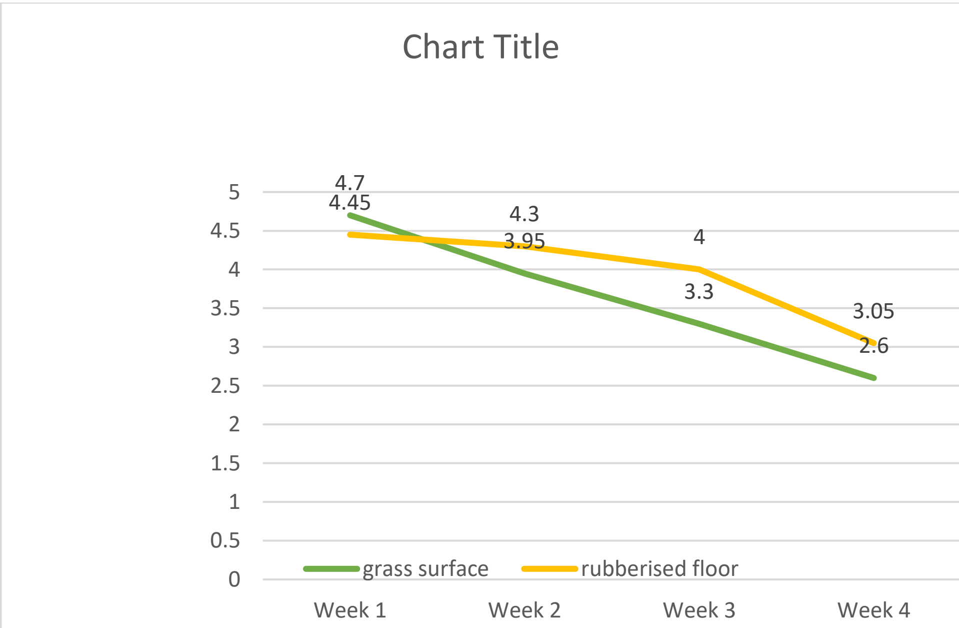

Figure -5. 4-week comparison of muscle soreness between grass and Rubberised Floor group

DISCUSSION

In the present study the Grass surface was used as training surface and the same plyometric exercises were given to the participant of Rubberised floor plyometric group. Pre and post training observations for speed, agility, explosive power and cardiovascular endurance and muscle soreness were compared within the group. The comparison of pre- and post- training observations, in grass plyometric training group, showed statistically significant improvement in all the four physical fitness variables studied in the present investigation i.e. agility, cardiovascular endurance, explosive power, speed and muscle soreness. There was a statistically significant decline in mean time taken to perform 50-meter sprint test, suggesting that speed of collegiate players was improved by 0.14 seconds, as a result of grass plyometric training. On the other hand, rubberised floor plyometric group showed decline of 0.32 sec. This improvement in sprint performance could be due to variations in stride length and stride frequency followed by plyometric training (Rimmer, 2000).

Similar results were found in context with Agility of grass and rubberised floor group participants which exhibited a statistically significant increase of 0.38 seconds and 0.30 respectively when assessed by dodging run test. According to Singh *et al.*, 2013 this improvement in agility could be because of better motor recruitment or neural adaptation. However, the improvement in agility is not much significant. Moreover, plyometric drills usually involve stopping, starting and changing direction in explosive manner and these components can assist in developing agility (Miller *et al.*, 2001; Yap *et al.*, 2000). These findings are well in line with the observation made by Miller *et al.* (2002); Asadi and Arazi (2012).

There was increase in participants' Vertical jump height when compared the pre training and post training readings. The mean increase in the height was 1.35 inches which was a significant improvement. There was increase in explosive power of the lower extremity after grass plyometric training. The same findings were seen in cardiovascular endurance was in the grass plyometric group, where was mean heart rate difference was pre-training (123 beats/min) to post- training (115 beats/min) and the change in overall mean cardiovascular endurance was 1.94. According to the present study there was decrease in mean muscle soreness when assessed by Likert scale, there was consecutive decline in the mean of soreness every week (4.7, 3.95, 3.3, 2.15). whereas the mean of soreness on rubberised floor plyometric training group was (4.45, 4.30, 4, 3.05) suggesting more muscles soreness than grass plyometric group.

CONCLUSION

The plyometric training in both, Grass as well as Rubberised floor surfaces are effective in improving the studied physical fitness variable in collegiate players and both the surfaces can be used as an alternative to each other for improving speed by using plyometric training. Plyometric on grass shows significant improvement on comparing with that on rubberised surface, with reference to cardiovascular endurance, explosive power and speed of players. Nevertheless, rubberised floor exhibited more soreness which may impose the athlete to higher risk of injury. The study concluded that grass plyometric training can be adopted by coaches and trainers as an effective training mode to enhance the performance of players with less muscle soreness.

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 male players. Furthermore, the study can be carried out in different age groups as well as different gender.

Declaration by Authors

Ethical Approval: Approved

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Conflict of Interest: The authors declare no conflict of interest.

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