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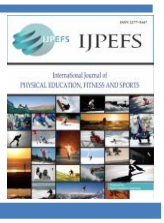

Effect of eight weeks land and sand based plyometric training on selected physical and physiological variables

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Abstract: The purpose of the study was to analyze the effect of eight weeks land based and sand based plyometric training on selected physical and physiological variables among inter collegiate level sportspersons pursuing their graduation under Kuvempu University. Subjects for the study were thirty (30) intercollegiate level sportspersons pursuing their graduation in Shivamogga. Their age ranged between 20 to 25 years. Purposive random sampling was observed in order to ascertain minimum levels of fitness of the sportspersons. Fifteen students each were placed randomly into plyometric training groups namely Land (N=15) and Sand (N=15) surfaces. In order to examine the efficacy of plyometric training on different surfaces following tests were conducted on all the subjects under the study. The subjects underwent these tests twice during the course of study i.e pre-test and post-test. The variables selected for the study were speed, dynamic strength, lower body explosiveness, agility, body composition and resting heart rate. Suitable standard tests were selected for assessing attributes. Paired sample 't' test was used as a statistical technique apart from descriptive statistics. Within the limitations of the present investigation it is concluded that the speed aspect of physical fitness can be significantly enhanced through sand based plyometric training as compared to land based plyometric training..

Key Words: plyometric, sand, land, physical fitness, physiological variables, explosiveness.

Introduction

Sports have become as competitive as other fields in the world. In ancient times, our ancestors exhibited the extraordinary talents in terms of physical activity. But now it has become completely professional. Somehow or other irrespective of age the human race is involved in different kinds of sports either for recreation or competition. In the present world, Sports have become extremely competitive.

Physical fitness provides capacity for activity. Physical fitness has been considered as one of the most important requirement of sports performance. Greater the physical fitness, better the physical endurance and precise the movement will be (Willgoose, 1961) [1]. In recent years, there has been record-breaking performance in diverse sports activities. Some of these were much beyond the expectations of sports coaches and physiologists. Several regions have been attributed to these amazing performances of the modern athletes. Some of the most important of which are improved techniques and training methods, better selection of the suitable activities and better nutrition (Walsh, 1961) [2].

Plyometric training has been shown to be one of the most effective methods for improving explosiveness in particular. Speed and strength are integral components of fitness found in varying degrees in virtually all athletic movements. Simply put the combination of speed and strength is power. For many years, coaches and athletes have sought to improve power in order to enhance performance. Throughout this century and no doubt long before, jumping, bounding and hopping exercises have been used in various ways to enhance athletic performance. In recent years, this distinct method of training for power or explosiveness has been termed plyometric. Whatever the origins of the word the term is used to describe the method of training that seeks to enhance the explosive reaction of the individual through powerful muscular contractions because of rapid eccentric contractions.

Strength and conditioning professionals have long relied on plyometric as one of the primary tools for developing athletic power and speed. It is not surprising that training exercises such as plyometrics, which are performed with high movement speeds would improve the performance of activities requiring speed, such as jumping, running, and agility (Ebben, 2007) [3].

Recommendations have been made to perform plyometric exercises on surfaces that are neither too hard nor soft, since these surfaces are thought to increase injury potential or prolong the amortization phase, respectively. In an attempt to evaluate the effects of surface type on plyometric training, studies have compared plyometric training in water versus a control group, plyometric training on land and in water, and training on grass versus sand surfaces (Ebben, et. al., 2012) [4].

Studies have examined acute biomechanical effects of plyometric exercises, isokinetic force, muscle soreness, ground reaction forces and power and take off velocity. These studies have compared plyometric performed on the ground versus a mini-trampoline and on hard versus sand surfaces. Research indicates that force, power, and take off velocity are higher on rigid compared to compliant surfaces during the takeoff phase of the plyometric exercise. Ground reaction forces have been shown to be higher on compliant surfaces during the landing phase of some plyometric exercises, potentially due to stiffer landings as a result of lower levels of lower body joint flexion on compliant surfaces such as sand (Ebben, et. al., 2012) [3].

Some strength and conditioning professionals suggest that performing plyometrics in the sand can result in greater improvements in performance without the impact on the skeletal muscular system seen in traditional plyometric environments.

On the basis of the study conducted by Impellizzeri, et. al. (2007) [5] it is concluded that there is no reason to perform plyometric training on sand, unless the athlete is training for a sport which is performed on sand.

It is well established that the training surfaces have prominent role to play on the quantum of improvement in different human performance variables. The investigator was of specific interest to examine the effect of land and sand based plyometric training on selected physical and physiological variables of inter collegiate level sportspersons pursuing their graduation. The purpose of the study was to analyze the effect of eight weeks land based and sand based plyometric training on selected physical and physiological variables among inter collegiate level sportspersons pursuing their graduation under Kuvempu University.

Methods

Subjects

Subjects for the study were thirty (30) intercollegiate level sportspersons pursuing their graduation in Shivamogga. Their age ranged between 20 to 25 years. Purposive random sampling was observed in order to ascertain minimum levels of fitness of the sportspersons. Fifteen students each were placed randomly into plyometric training groups namely Land (N=15) and Sand (N=15) surfaces.

Criterion measure

In order to examine the efficacy of plyometric training on different surfaces following tests were conducted on all the subjects under the study. The subjects underwent these tests twice during the course of study i.e pre-test and post-test. List of tests and variables measured are given in table 1.

Method of data collection

Prior to the administration of the test the investigator had a meeting with the subjects. The objectives and importance of the tests were made clear to the subjects at the outset. Demonstration of the test was done by the investigator if there were any ambiguities in terms of understanding of the test by subjects. Further a written consent was taken from subjects as well as their guardians. A Pre-test and a Post-test was conducted on the same subjects with a time gap of 8 weeks.

Experimental design

The study included purposive random group pre-test and post-test design. Plyometric exercises were selected from textbooks (Radcliffe and Farentinos, 1999 [6]; and Chu, 1998 [7]), internet and finalized after an extensive review of literature.

Statistical techniques

Descriptive statistics like Mean and Standard Deviations were calculated in order to make inferences. In order to test the hypotheses of the study paired sample 't' test was employed.

Findings

The results of land based plyometric training group relating to physical and physiological parameters during pre and post-test situations were subjected to descriptive statistics. The results are given in table 2.

Table1. Details on testing protocol and variables selected for study

S. No.	Parameters	Variables Measured	Testing Protocol
1.	Physical	Height	Stadiometer
2.		Weight	Standard weighing machine
3.		Speed	50 meters sprint
4.		Dynamic Strength	Sit Ups (1 minute)
5.		Lower body explosiveness	Three hop test
6.		Agility	Illinois agility test
7.	Physiological	Body Composition	Body Mass Index (BMI)
8.		Resting Heart Rate	Radial pulse

Table 2. Descriptive statistics of land based plyometric training group during pre and post test situations

Variables		Land based		Sand based	
		Mean	Std. Deviation	Mean	Std. Deviation
Explosiveness (in meters)	PRE	6.59	.58	6.59	.77
	POST	6.62	.58	6.90	.80
Strength (in counts)	PRE	19.50	4.91	16.64	4.11
	POST	21.86	5.70	22.64	4.68
Agility (in seconds)	PRE	19.75	1.47	19.14	.84
	POST	19.23	1.46	18.53	1.23
Speed (in seconds)	PRE	7.86	1.00	7.30	.49
	POST	7.68	.94	7.01	.55
BMI	PRE	21.55	2.39	21.85	2.44
	POST	21.86	2.52	21.62	2.22
Heartrate (in counts)	PRE	74.79	7.08	77.14	7.52
	POST	72.71	6.52	74.86	8.80

The raw scores of land based plyometric training group on physical and physiological parameters during pre and post-test situations were subjected to 't' test and the results are given in table 3.

Table 3. Summary of 't'test on physical and physiological parameters during pre and post test situations of land group

Variables	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Explosiveness	-.02857	.14271	.03814	-.749	13	.467
BMI	-.31071	1.25772	.33614	-.924	13	.372
Strength	-2.35714	2.67775	.71566	-3.294	13	.006
Agility	.52571	.51868	.13862	3.792	13	.002
Speed	.17929	.37879	.10124	1.771	13	.100
Heartrate	2.07143	3.62607	.96911	2.137	13	.052

Table 3 on 't' test makes it clear that there is significant difference in strength aspect of land based plyometric training group between pre and post-test situations with a 't' test score of (-3.294); significant difference was observed in agility between pre and post-test situations with a 't' test score of (3.792); significant difference was observed in heart rate between pre and post-test situations with a 't' test score of (2.137). It suggests that the strength, agility and heart rate of land based plyometric training group during post-test significantly improved from pre-test situation.

The raw scores of sand based plyometric training group on physical and physiological parameters during pre and post-test situations were subjected to 't'test and the results are given in table 4.

Table 4 on 't' test makes it clear that there is significant difference in explosiveness aspect of sand based plyometric training group between pre and post-test situations with a 't' test score of (-7.070); strength aspect of sand based plyometric training group between pre and post-test situations with a 't' test score of (-4.642); significant difference was observed in agility between pre and post-test situations with a 't' test score of (2.615); speed aspect of sand based plyometric training group between pre and post-test situations with a 't' test score of (4.897). It suggests that the explosiveness, strength, agility and speed during post-test of sand based plyometric training group significantly improved from pre-test situation.

The raw scores of land and sand based plyometric training group on physical and physiological parameters during post-test situations were subjected to 't' test and the results are given in table 5.

Table 5 on 't' test makes it clear that there is significant difference in speed aspect during post-test situation between land and sand based plyometric training groups with a 't' test score of (2.758). It suggests that the speed aspect significantly improved in sand group during post-test situation.

Discussion

In the present study on effectiveness of eight weeks plyometric training on land and sand surfaces it was observed that some of the physical and physiological aspects of inter collegiate level sportspersons improved. Plyometric training on land alone improved strength, agility and heart rate. Similarly, plyometric training on sand alone improved explosiveness, strength, agility and speed. Further, it was observed that the speed of inter collegiate level sportspersons significantly improved during post-test situation due to plyometric training on sand surface.

Faigenbaum, et. al., (2007) [8] demonstrated that the addition of plyometric training to a resistance training program was more effective than resistance training and static stretching in improving upper and lower body power performance in boys.

Table 4. Summary of 't' test on physical and physiological parameters during pre and post test situations of sand group

	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Explosiveness	-.30429	.16104	.04304	-7.070	13	.000
BMI	.22714	.45174	.12073	1.881	13	.083
Strength	-6.00000	4.83576	1.29241	-4.642	13	.000
Agility	.60857	.87092	.23276	2.615	13	.021
Speed	.28714	.21942	.05864	4.897	13	.000
Heart rate	2.28571	4.73008	1.26417	1.808	13	.094

Table 5. Summary of 't' test on land and sand based training groups in physical and physiological parameters during post-test situation

Variables and groups	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Explosiveness land-sand	-.27786	.87322	.23338	-1.191	13	.255
BMI land-sand	-.07286	3.17380	.84824	-.086	13	.933
Strength land-sand	-.78571	6.81829	1.82226	-.431	13	.673
Agility land-sand	.69500	1.81181	.48423	1.435	13	.175
Speed land-sand	.66500	.90212	.24110	2.758	13	.016
Heart rate land-sand	-2.14286	8.80434	2.35306	-.911	13	.379

According to Ebben (2012) [4] complex training can be an efficient way to organize combined weight training and plyometric training since both types of training can be performed during the same session in the same facility.

Study by Arazi and Asadi (2011) [9] indicated that the 8-week of aquatic and land plyometric training in young basketball players can enhance the strength, sprint and balance performance. Further, it was concluded that plyometric training is more effective than regular practice in improving not only strength, jumping power and balance but also sports specific skills of basketball players (Sharma and

Multani, 2012). But it is still unclear as to which surface produces the highest results.

According to Miller, et. al., (2006) [10] athletes can use plyometrics to break the monotony of training, but they can also improve their strength and explosiveness while working to become more agile.

Plyometric can be thought of as one of the important tools in the tool box for those who wish to add another dimension to their training programs. If improving variables such as speed, jumping ability, and agility is a goal, plyometric may be the most important of these tools.

Conclusion

Within the limitations of the present investigation it is concluded that the speed aspect of physical fitness can be significantly enhanced

through sand based plyometric training as compared to land based plyometric training.

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