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The Comparative Effect of Hill Training and Plyometric Training on Speed and Vertical Explosive Power among Football Players

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Abstract

This study compared the effects of hill training and plyometric training program on the following functional tests: Speed (35 m sprint speed test - best of three trials) Vertical explosive power (sergeant jump test).To achieve the purpose of the study, 48 male football players were selected from the Government Higher Secondary School, Thuvarankurichy, Trichy District at randomly. They were randomly assigned in to Hill training group (n = 16), Plyometric Training group (n = 16), and a control group (n = 16). Experimental groups trained three days a week for 12 weeks. The collected data were statistically analyzed with paired sample't' test was used to find out significant improvement and analysis of covariance (ANCOVA) was used to find out the significant difference among experimental and control groups and the Scheffe's test was applied as post-hoc test to find out paired mean difference was significant. In all the cases 0.05 level of confidence was fixed to test the hypothesis.This study concluded that the hill training was significantly effective in improving the speed and Vertical explosive power than plyometric training group of football players.

Keywords: Hill Training, Plyometric, Speed, Explosive Power, Football.

Introduction

"Physical fitness refers to the capacity of an athlete to meet the varied physical demands of their sport without reducing the athlete to a fatigued state. Motor Fitness refers to the ability of an athlete to perform successfully at their sport. (Davis 2000). Tancred (1995) believes that: "One of the misconceptions in the sports world is that a sports person gets in shape by just playing or taking part in his/her chosen sport. If a stationary level of performance, consistent ability in executing a few limited skills is your goal, then engaging only in your sport will keep you there. However, if you want the utmost efficiency, consistent improvement, and balanced abilities sportsmen and women must participate in year round conditioning programs. The bottom line in sports conditioning and fitness training is stress, not mental stress, but adaptive body stress. Sportsmen and women must put their bodies under a certain amount of stress (overload) to increase physical capabilities.

Hill running has a strengthening effect as well as boosting your athlete's power and is ideal for those athletes who depend on high running speeds - football, rugby, basketball, cricket players and even runners. To reduce the possibility of injury hill training should be conducted once the athlete has a good solid base of strength and endurance, Tulloh (1992). Downhill running only (using the over-speed principle) "increased [an] athlete's maximal speed by 6.5% when performed at a slope of 5.8° compared with flatland running." The research also covered other angles of slope ranging from two to seven degrees, Ebben W (2008). Using both uphill and downhill running resulted in "an increase of maximal running speed by 3.4% accompanied by an increase of step rate by 3.4%, although the step length did not change Unless you confine your competitions to the track, hills are a fact of life for every runner. Obviously, running up a hill takes more energy than running over flat ground, and running down a hill saves energy.

Most runners concentrate solely on running up hill intervals with very slow down hill recoveries; however research suggests that the combination of uphill and downhill intervals may be particularly effective at improving the maximum running speed (Paradises et al., 2009; Paradises and Cooke, 2006). A 2005 study by Jinger Gottschall and Rodger Kram quantified the difference in impact during uphill and downhill running.2 Using a force plate and an adjustable-incline treadmill, Gottschall and Kram calculated both the impact force and braking/propulsive force. The braking and propulsive forces are the resistances the foot encounters in the forward and backward direction (parallel to the ground), respectively, vs. the downward resistance encountered in the impact force For running at an even pace on flat ground, the propulsive force and braking force are about equal. Ten subjects ran at inclines ranging between +9° and -9°.In contrast, the

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impact force virtually disappeared during uphill running, while the propulsive force increased 74%. This should not be too much of a surprise, since gravity is doing most of the propulsion on the way down, but you have to do it on the way up. Gottschall and Kram's study used a treadmill at a constant pace when taking these measurements—in the real world, when running at an even effort, you will slow down on an uphill and speed up on a downhill. So the effects (particularly the increased impact forces) will be magnified.

The term "plyometrics" refers to specific exercises which encompass a rapid stretching of muscle that is undergoing eccentric stress followed by a concentric, rapid contraction of that muscle for the purpose of developing a forceful movement over a short period of time (Chu, 1983). One particular plyometric activity, the depth jump, has been shown to improve power in the vertical jump (Batholemew, 1985; Miller, 1982; Parcells, 1977; Verkhoshanski & Tatyan, 1983). Depth jumps are a type of dynamic exercise where an individual steps off a box 20 to 80 centimeters in height, lands, and performs an explosive vertical jump (Wilson, Murphy, & Giorgi, 1996). The depth jump is thought to enhance vertical jump performance through the quickening of the amortization phase, which is the electromechanical delay from the initiation of eccentric to the initiation of concentric muscle actions of the movement (Steben & Steben, 1981).Many sports require the ability to generate high amounts of force in relatively short periods of time. The ability to express high rates of force development is often related to an athlete's overall strength levels and ability to express high power outputs. Stone et al. suggested that the ability to express high rates of force development and high power outputs are critical performance characteristics central to success in most sporting events. These abilities are considered to be among the most important sports performance characteristics, especially in activities that rely on jumping, change of direction, and/or sprinting performance. Short recovery period between sprint intervals for the purpose of phosphate energy system adaptation do not appear to be effective and enhancing motor skill development. Rest period lasing in excess of 6 minutes may improve speed more effectively (Merlau 2005).The aim of the present study was to determine the comparative effect of hill training and plyometric training on speed and vertical explosive power among football players.

Methodology

Forty eight actively playing football players volunteered for this study, they were selected from the Government Higher Secondary School, Thuvarankurichy, Trichy District at randomly (Table 1). The participants did not perform either hill training or plyometric of their training schedule for a period of at least three months prior to the study. Participants were randomly assigned to one of three groups: Hill training group, Plyometric training group, and a control group that did not train.

Testing Protocol

The pre test and post test randomized control group design was used as experimental design.

1. Speed (35 m sprint speed test - best of three trials)
2. Vertical explosive power (sergeant jump test)

Training Protocol

Five to ten minutes jogging - to increase body temperature, 10 to 15 minutes dynamic stretching exercises - reduce muscle stiffness, 10 to 15 minutes general and event specific drills - preparation for the session or competition.

Hill training

The player's they were start their training after warm up.(High knee – 15mts uphill / slow jog down recovery (6×3), 2min rest between rep & 5 min rest between set. 30 mts run for speed – downhill sprinting (6×3), 2min rest between rep & 5 min rest between set. 50 fast ×50 slow uphill for 1000 mts (1000 ×2) 5 to 7 min rest between sets. The above training was given to all the three days per week/ over a period of twelve weeks. The effort of training starting from 65 - 75% progressively increased to 75 to 85 %(for one repetition) at the end of the training.

Plyometric training

The player's they were start their training after warm up.

1. Standing based jumps performed on the spot (low intensity) - Tuck Jumps, Split Jumps. Jumps from standing (low-medium intensity) - Standing long jump, Standing hop, Standing jump for height.
2. Multiple jumps from standing (medium intensity) - bounds, bunny hops, double footed jumps over low hurdle, double footed jumps up steps. Multiple jumps with run in (High intensity) - 11 stride run + 2 hops and a jump into sandpit, 2 stride run in + bounds.
3. Depth jumping (high-very high intensity) - jumps down and up off box (40 to 100cm), bounding up hill.

The above training was given to all the three days per week over a period of twelve weeks respectively. Five to ten minutes jogging/walking - decrease body temperature and remove waste products from the working muscles.5 to 10 minutes static stretching exercises.

Data Analysis

The collected data from the three groups prior to and immediately after the training programme on selected criterion variables was statistically analyzed with paired sample't' test was used to find out significant improvement and analysis of covariance (ANCOVA) was used to find out the significant difference among experimental and control groups. Whenever the 'F' ratio for adjusted post test means was found to be significant,

the Scheffe's test was applied as post-hoc test to find out paired mean difference was significant. In all the cases 0.05 level of confidence was fixed to test the hypothesis

Results

Table I. Descriptive group data

Subject details	Hill training group	Plyometric training group	Control group
Number	16	16	16
Height (cm)	165 ± 7.5	162 ± 10.2	164 ± 5
Mass(kg)	68.6 ± 5.5	70.6 ± 4.5	65.6 ± 5.7
Age (yr)	16 ± 2.6	16 ± 1.7	16 ± 2.2

Table II. Computation of Mean, SD and 'T' Ratio of Pre & Post Tests of Training & control Groups on speed and Vertical explosive power of football players

Criterion Variables	Group	test	Mean	SD	t'- Ratio
Speed	Hill training	Pre test	5.75	0.1939	9.24*
		Post test	5.28	0.1698	
	Plyometric	Pre test	5.80	0.3423	4.62*
		Post test	5.53	0.2076	
	Control	Pre test	5.77	0.2802	1.49
		Post test	5.76	0.282	
Vertical explosive power	Hill training	Pre test	46.31	4.1588	24.24*
		Post test	63.38	3.4424	
	Plyometric	Pre test	46.31	5.0029	7.15*
		Post test	53.81	4.1668	
	Control	Pre test	46.19	5.1279	1.59
		Post test	47.13	5.0448	

Significant at 0.05 levels. Degrees of freedom n-1=15 is 2.13.

Table II shows that the obtained't' ratio value of experimental groups on ***speed*** Are 9.24*, and 4.62* which are higher than the table value of 2.13 with df 15 at 0.05 level of significance and the obtained't' ratio value of experimental groups on Vertical explosive power are 24.24*and 7.15* which are higher than the table value of 2.13 with df 15 at 0.05 level of significance.. Therefore, the results of the study indicate that there was significant improvement between pre and post test means of experimental group on the development of speed and vertical explosive power of football players. The results of the study also indicate that there was no significant improvement between the pre and post test means of control group on the development of speed and vertical explosive power of football players.

Table III. Analysis of covariance on criterion variables of experimental groups

Criterion Variables	Adjusted post test means			Source of variance	Sum of Squares	df	Mean Squares	'F'- Ratio
	Hill training	Plyometric training	Control group					
Speed	5.29	5.51	5.76	B	1.69	2	0.85	40.15*
				W	0.93	44	0.02	
Vertical explosive power	63.35	53.78	47.18	B	2113.84	2	1056.92	130.95*
				W	355.13	44	8.07	

*Significant at 0.05 level of confidence.
(The table value required for significance at 0.05 levels with df 2 and 44 is 3.21).

From the table III, the obtained F- ratio of speed and vertical explosive power for adjusted post test means were 40.15* and 130.95* respectively which are more than the table value of 3.21 for df 2 and 44 required for significant at .05 level of confidence. The results of the study indicate that there is significant difference among the adjusted post test means of Hill training, Plyometric training and control groups on speed and vertical explosive power due to the effect of training.

Table IV. Scheffe's Paired Mean Difference of Experimental and Control Groups on speed

Hill training	Plyometric training	Control group	Paired Mean Difference	C.I.Value
5.29	5.51		0.22	0.13
5.29		5.76	0.47	0.13
	5.51	5.76	0.25	0.13

*Significant at .05 level of confidence.

Table IV shows that the paired mean differences on speed of hill training and Plyometric training, Hill training and Control group, and Plyometric training and control groups are 0.22, 0.47 and 0.25 respectively. These values are greater than the confidence interval value of 0.13.The result of the study shows that there were significant differences between hill training and Plyometric training, Hill training and Control group and Plyometric training and control groups since the mean differences were greater than the confidence interval value of 0.13. While considering the two experimental groups, from the results presented in the table –IV it was found that the Hill training group was better than plyometric training on speed development of football players.

Table V. Scheffe's Paired Mean Difference of Experimental and Control Groups on Vertical explosive power

Hill training	Plyometric training	Control group	Paired Mean Difference	C.I.Value
63.35	53.78		9.57	2.54
63.35		47.18	16.17	2.54
	53.78	47.18	6.6	2.54

*Significant at .05 level of confidence.

Table V shows that the paired mean differences on Vertical explosive power of hill training and Plyometric training, Hill training and Control group, and Plyometric training and control groups are 9.57, 16.17 and 6.6 respectively. These values are greater than the confidence interval value of 2.54.The result of the study shows that there were significant differences between hill training and Plyometric training, Hill training and Control group, and Plyometric training and control groups since the mean differences were greater than the confidence interval value of 2.54.While considering the two experimental groups, from the results presented in table –V it was found that hill training group was better than Plyometric training on Vertical explosive power of football players.

Findings

The following findings were obtained from the results of the Scheffe's Paired Mean Differences of Experimental and Control Groups on dependent variables.

While considering the two training groups, from the results presented in the Scheffe's Paired Mean Difference tables it was found that Hill training group were significantly improved on speed and Vertical explosive power than compare to plyometric training group.

Conclusions

From the analysis of the results, the following conclusions were drawn.

1. There was significant improvement on speed and Vertical explosive power of Football players due to the effect of hill and plyometric training.
2. The hill training was significantly effective in improving the speed and Vertical explosive power than plyometric training group of football players.
3. The results of the study indicate that there is significant difference among the adjusted post test means of Hill training, Plyometric training and control groups on speed and vertical explosive power due to the effect of training.

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