

FULL LENGTH ARTICLE

Effect of various hill running programme on power and reaction time

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Abstract: The purpose of the present study was to find out the effect of uphill, downhill and combined running programme on power and reaction time. To achieve the purpose of this study, sixty male students were selected randomly from Department of Physical Education & sports Sciences, Annamalai University, Tamilnadu State, India, The selected subjects age ranged from 18 to 25 years. They are divided into four equal groups, each group consists of fifteen subjects. The uphill, downhill and combined running programme were given to twelve weeks, in which uphill running programme with 3° inclination, downhill running programme with 3° declinations and combined the running programme with 3° inclination and 3° declinations were given to the three experimental groups separately and the control group did not participate in any special training programme. Prior to and after the training period, the subjects were tested power and reaction time. They were measured by new test power timer. The obtained data were analyzed by analysis of Co-variance (ANCOVA) if, F ratio was found to be significant, Scheffe's post hoc test was used. In all the cases, 0.05 level of confidence was fixed to test the significance. It was concluded that the uphill, downhill and combined running groups significantly improved power and reaction time as compared to control group. Combined running programme significantly improved power as compared to uphill running and downhill running groups. There was no significant variation in reaction time among all the three experimental groups.

Keywords: Uphill Running, Downhill Running, Combined Running, Power and Reaction Time.

1 Introduction

Hill running has a strengthening effect as well as boosting 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. Hill work results in the calf muscles learning to contract more quickly and thereby generating work at a higher rate, they become more powerful. The calf muscle achieves this by recruiting more muscle fibres, around two or three times as many when compared to running on the flat. The "bouncy" action also improves the power of the quadriceps in the front of the thigh as they provide the high knee lift that is required. For the athlete, when competing in their sport/event, it can

mean higher running speeds and shorter foot strike times.

The training with hills increases both the number of muscles fibers being used and in the use of different muscles that would otherwise not be used. Using a greater number of muscles and a greater amount of muscle fibers within those muscles must surely increase performance. "Hill training is almost as effective in building aerobic power as track interval training," says (2:27 marathoner and USA T&F Distance Coach) Chris Phelan. "And it's far more effective in building strength." Indeed, running uphill strengthens hamstrings, calves, glutes, hip flexors, and Achilles tendons more than flat running, and it uses more upper-body muscles. "Hill running is resistance training for runners," says Phelan, "because athlete is fighting the resistance of the slope. It is extremely demanding at first because work muscles that don't use often." Harper (2007).

In uphill running there exist two major difficulties. The first one is physical, caused by the necessity to move the body weight up against gravity, which increases accordingly the body response by increasing muscular efforts and energy spending compared to flat running Romanov (2006). The downhill running requires much more control of body position, a proper upper body - lower body (feet) interaction, a general reduction of efforts and a much higher cadence. They have to put their feet low above the ground and reduce their muscle tension and efforts on landing. If they follow these rules, their uphill and downhill running will be effective and their race performance will be improved as well Romanov (2005). The mixed hill running can also be used to improve running economy and boost an athlete's VO₂ max Mackenzie (2007).

Methodology

The purpose of the present study was to find out the effect of uphill, downhill and combined running programme on power and reaction time. To achieve the purpose of this study, sixty male students were selected randomly from Department of Physical Education & sports Sciences, Annamalai University, Tamilnadu State, India, The selected subjects age ranged from 18 to 25 years. They are divided into four equal groups, each group consists of fifteen subjects. The uphill, downhill and combined running programme were selected as independent variables for this study. The power and reaction time were selected as dependent variables. The data obtained were analyzed by analysis of Co-variance (ANCOVA) to assess the significant difference between in the adjusted post-test means, for each of the variables of uphill, downhill and combined running groups and control group separately. Whenever the F ratio was found to be significant, Scheffe's post hoc test was used to find out a significant difference in the paired means. In all the cases, 0.05 level of confidence was fixed to test the significance,

Training Programme

The interventional treatment for experimental group-I underwent uphill running with 3° inclination, experimental group-II underwent downhill running with 3° declination and experimental group-III underwent combined running with 3° inclination and 3° declination. The experimental period was for twelve weeks. On every day of the training session and the training schedule were done approximately from forty-five to sixty minutes. These included 1 minute rest between the repetitions, 5 minutes rest between the set, warming up and cool down also. Group-IV was instructed not to participate in any special training programme and

requested to do regular work throughout of the study. Prior to and after the training period the subjects were tested power and reaction time. They were measured by new test power timer.

Load Dynamics

The initial intensity of training for uphill and downhill running programme were fixed at 70% of the group's personal best performance. The training intensity for each distance was calculated based on the time taken to perform the particular training distance. For combined running training programme, the uphill and downhill running were combined and the distance was reduced to half i.e. 30 meters for each uphill and downhill so as to meet the criteria of equal distance of 60 meters. The 70% of intensity progressively an over load the 5 repetitions X 3 sets programs was implemented during I to III week. Thereafter 10 % of load was increased and maintained 4 repetitions X 3 sets for IV to VI weeks. For the VII to IX weeks 10 % of load was increased and maintained 3 repetitions X 3 sets than the 10 % of load was increased and maintained 2 repetitions X 3 sets for X to XII weeks. The sets and repetitions. The subjects were placed under active rest in between repetitions and complete recovery between the sets and it was increased once in three weeks by 10%.

The table-I shows that the adjusted post- test mean on power of uphill running group is 45.44, downhill running group is 46.78, combined running group is 50.50 and control group is 43.36, which resulted with an 'F' ratio of 174.86 and it is higher than the table value of 2.78 required for df 3 and 55 at 0.05 level of significance. It is found that significant differences exist among the four groups on power after adjusting the initial mean differences on the post-test means.

The table-I shows the adjusted post- test mean on reaction time of uphill running group is 0.2070, downhill running group is 0.2060, combined running group is 0.2010 and control group is 0.2240, which resulted with an 'F' ratio of 21.770 and it is higher than the table value of 2.78 required for df 3 and 55 at 0.05 level of significance. It is found that significant differences exist among the four groups on reaction time after adjusting the initial mean differences on the post-test means.

An examination of the table-II indicates that the adjusted post-test mean difference on power between control group and uphill running group, control group and downhill group and between control group and combined group consisting of uphill and downhill running are 2.10, 3.42 and 7.14 respectively which are higher than the confidence interval value of 0.91 at 0.05 level of significance. It is inferred that the twelve weeks of uphill, downhill and

TABLE – I

Analysis of covariance for pre- and post-test data on power and reaction time among uphill, downhill, combined running groups and control group

		Uphill Training Group	Downhill Training Group	Combined Training Group	Control Group	S O V	Sum of Squares	df	Mean Squares	'F' ratio
Power	Pre-test Mean	43.00	44.27	43.33	42.53	B:	24.18	3	8.10	0.60
	SD	2.73	4.00	5.12	2.10	W:	754.0	56	13.46	
	Post-test Mean	45.20	47.60	50.53	42.73	B:	500.3	3	166.77	
SD	3.01	3.31	4.03	2.10	W:	568.6	56	10.16		
	Adjusted Mean	45.44	46.78	50.50	43.36	B:	402.1	3	134.05	174.8*
						W:	42.16	55	0.77	
Reaction Time	Pre-test Mean	0.2293	0.2240	0.2280	0.2220	B:	0.001	3	0.000	0.714
	SD	0.020	0.015	0.013	0.013	W:	0.014	56	0.000	
	Post-test Mean	0.2107	0.2040	0.2033	0.2095	B:	0.003	3	0.001	
SD	0.023	0.017	0.012	0.014	W:	0.016	56	0.000		
	Adjusted Mean	0.2070	0.2060	0.2010	0.2240	B:	0.004	3	0.001	21.770*
						W:	0.004	55	0.000065	

*Significant at 0.05 level of confidence.

*The table value required for significance at 0.05 level with df 3 & 56, and 3 & 55 are 2.776 and 2.78 respectively

combined running programme have significantly improved power in three experimental groups as compared to the control group.

Table-II also shows the mean difference between uphill running group and combined running group is 5.06, downhill running group and combined running group is 3.72 which are more than the confidence interval value 0.91 at 0.05 level of significance. The result reveals that the combined running group has shown significant improvement in power as compared to the uphill and downhill running groups. The mean difference between uphill and downhill running groups is 1.34 and it is more than confidence interval value of 0.91 at 0.05 level of significance. The result shows that the downhill running group shows significant difference on power

as compared to uphill running group, An examination of the table-II indicates that the adjusted post-test mean difference on reaction time between control group and uphill running group, control group and downhill group and between control group and combined group consisting of uphill and downhill running are 0.0170, 0.0180 and 0.0230 respectively which are higher than the confidence interval value of 0.0083 at 0.05 level of significance. It is inferred that the twelve weeks of uphill, downhill and combined running programme have significantly decreased in reaction time in three experimental groups as compared to the control group.

Table-II also shows the mean difference between uphill running group and combined running group is 0.0060, downhill running group and combined

TABLE II
Scheffe’s post hoc test for the adjusted post-test paired means difference on power and reaction time

	Adjusted Post-Test means				Mean difference	Confidence interval
	Uphill Training Group	Downhill Training Group	Combined Training Group	Control Group		
Power	45.44			43.36	2.10*	0.91
		46.78		43.36	3.42*	0.91
			50.50	43.36	7.14*	0.91
	45.44		50.50		5.06*	0.91
		46.78	50.50		3.72-*	0.91
	45.44	46.78			1.34*	0.91
Reaction Time	0.2070			0.2240	0.0170*	0.0083
		0.2060		0.2240	0.0180*	0.0083
			0.2010	0.2240	0.0230*	0.0083
	0.2070		0.2010		0.0060	0.0083
		0.2060	0.2010		0.0050	0.0083
	0.2070	0.2060			0.0010	0.0083

*Significant at 0.05 level of Confidence.

the running group is 0.0050 and between uphill and downhill running groups is 0.0010 which are lower than the confidence interval value 0.0083 at 0.05 level of significance. The result reveals that all the three experimental groups have no significant changes in reaction time among the experimental groups.

Discussion on Findings

The findings of this study are in agreement with the findings of Paradisis, et al., (2009) who reported that the effects of 8-week sprint running training on sloping surfaces (3°) (uphill-downhill) improved reaction time, and step time of physical education students. Baker and Nance (1999) have stated that the force produced or the heights obtained during concentric jump tests appear to be very good predictors of sprint performance in uphill and downhill. The study highlights the importance of jump height and power for athletes. Kukulj et al., (1999) noticed that the uphill and downhill running improved power and closely related with sprinting performance. This study is also in agreement with the findings of Paradisis, et al., (2006) who stated that the effects of 6 week sprint running training on sloping surfaces (3°) (uphill-downhill) improved step time, contact time, eccentric and concentric phase of contact time and power (shortened) for physical

education students. This study is again in agreement with the findings of Paradisis and Cooke (2001) who have detailed the effects of sprint running on (a) uphill at 3°, (b) downhill at 3° and (c) horizontal. The uphill-downhill running improved contact time (reaction time) and flight time of physical education students. Telhan et al., (2010) have indicated that the parallel ground reaction forces during downhill and uphill running improved the reaction time. These findings supported the findings of power and reaction time of the present study.

Conclusion

It was concluded that the uphill running, downhill running and combined running programme significantly improved power and reaction time as compared to control group. Combined running programme significantly improved power as compared to uphill running and downhill running groups. Downhill running programme significantly improved power as compared to uphill running group. It was found that no significant variation in reaction time among all the three experimental groups.

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