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Original Article

Effects of Circuit Training, Weight Training, and Combined Training on Selected Physical Fitness Variables among Inter-collegiate Men Hockey Players

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ABSTRACT

The purpose of this study is to determine the effect of circuit training, weight training, and combined training on select physical fitness variables, namely, speed and agility among college level players of hockey. To achieve this purpose of the study, 45 players ranging from 18 to 25 years from Tamil Nadu, were randomly selected as subjects (N = 45); and divided into three equal groups of 15 players each. The study was formulated as a true random group design, consisting of a pre-test and post-test. As the subjects (N = 45) were randomly assigned to these three groups, training such as circuit training, weight training, and combined training group (COTG) were assigned in an equivalent manner. While Group I underwent circuit training; Group II underwent weight training; and Group III underwent combined training. The three experimental groups participated in the training for a period of 2 weeks to find out the outcome of the training packages. The variable to be used in the present study was collected from all subjects before they had to be treated with the concerned treatments. This was assumed as pre-test; yet again, after completion of treatment they were tested again as post-test. Analysis of covariance (ANCOVA) was applied as the subjects were selected at random; but the groups were not equated in relation to the factors to be examined. Hence, the difference between the means of the three groups in the pre-test had to be taken into account during the analysis of the post-test differences. This was made possible by the application of the ANCOVA, where the final means were adjusted for differences in the initial means, and the adjusted means were tested for significance. Whenever the adjusted post-test means were found significant, the Scheffe's *post hoc* test was administered to find out the paired means difference. To test the obtained results on variables, level of significance 0.05 was chosen. The COTG produced significant improvement on selected physical fitness variables than the other groups.

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INTRODUCTION

A change in one of the components of the shoulder girdle leads to a complete change in shoulder motion. The orientation of the scapula is predicted in the upright position mainly from the length of the trapezius and levator scapulae muscles, and to a lesser extent from the length of the rhomboids and serratus anterior muscle.[1,2] In recreational athletes same symmetry between the two shoulders in all the measured variables. As in tennis or baseball players, volleyball players also have a depressed playing shoulder. This leads to a narrowed subacromial space in the upright position.[3] Some researchers suggested that a circuit-based training consisting of endurance and resistance exercises might be preferred, rather than one focused only on a single mode of exercise[4,5] even if not all researchers agreed.[6,7] Resistance training and aerobic exercise are established approaches to help manage obesity and associated risk factors.[8,9] Both types of exercise have been prescribed to sedentary and obese individuals, and resulted in improved blood pressure (BP), heart rate, body composition, biochemical markers (insulin, glucose, cholesterol, etc.), and strength.[10,11] Combination training (i.e., aerobic and resistance training combined) appears to have a greater effect on BP, arterial stiffness, body composition, and then performing either type of exercise independently.[12,13]

METHODOLOGY

The purpose of the study was to determine the effect of circuit training, weight training, and combined training on

selected physical fitness variables, namely, speed and agility among college level players of hockey. To achieve the purpose of this study, 45 players from Tamil Nadu were selected as subjects at random; with age ranging between 18 and 25 years. The subjects were divided into three equal groups comprising 15 players each. The study was formulated as a true random group design, consisting of a pre-test and post-test. The subjects ($N = 45$) were then randomly assigned to the three groups, along with circuit training group (CTG), weight training group (WTG), and combined training group (COTG) in an equivalent manner. While Group I underwent circuit training, Groups II and III underwent resistance training and combined training, respectively. The three experimental groups participated in the training for 12 weeks to find the outcome of their training packages. The variable used in the present study was collected from all subjects before they have to be treated with the respective treatments, and was assumed as a pre-test. After completion of treatment, they were tested again on all variables used in this study; and was assumed as post-test. Analysis of covariance (ANCOVA) was applied because the subjects were selected at random, but the groups were not equated in relation to the factors to be examined. Hence, the difference between means of the three groups in the pre-test had to be taken into account while analyzing the post-test differences. This was achieved by applying ANCOVA, where the final means were adjusted for differences in the initial means, and the adjusted means were tested for significance. Whenever the adjusted post-test means were found significant, Scheffe's *post hoc* test was administered to find out the paired means difference. To test the obtained results on variables, level of significance 0.05 was chosen as sufficient for the study.

RESULTS

Table 1 summarizes that the indicated and the obtained "F" ratio for the pre-test means among the groups on speed were 7.11 for experimental Group I, 7.24 for experimental Group II, and 7.15 for experimental Group III. The obtained "F" ratio 1.31 was lesser than the table "F" ratio 3.21. Hence, the pre-test mean "F" ratio was insignificant at 0.05 level of confidence for the degree of freedom 2 and 42. The post-test means were 6.97 for experimental Group I, 70.00 for experimental Group II, and 6.78 for experimental Group III. The obtained "F" ratio 85.85 was higher than the table "F" ratio 3.21. Hence, the post-test mean "F" ratio was significant at 0.05 level of confidence for the degree of freedom 2 and 42. The adjusted post-test means were 6.98 for experimental Group I, 7.01 experimental Group II, and 6.78 for experimental Group III. The obtained "F" ratio 92.42 was higher than the table "F" ratio 3.22. Hence, the adjusted post-test mean "F" ratio was significant at 0.05 level of confidence for the degree of freedom 2 and 41. It was concluded that there was a significant mean difference among CTG, WTG, and COTG, in developing the speed of the hockey players [Figure 1].

Table 2 summarizes the *post hoc* analysis obtained on adjusted post-test means. The mean difference required for the confidential interval to be significant was 0.19. It was observed that the COTG significantly improved better speed than the other groups.

Table 3 summarizes that the indicated and the obtained "F" ratio for the pre-test means among the groups on agility were 11.35 for experimental Group I, 11.30 for experimental Group II, and 11.24 for experimental Group III. The obtained "F" ratio 1.11 was lesser than the table "F" ratio 3.21. Hence, the pre-test mean "F" ratio was insignificant at 0.05 level of confidence for the degree of freedom 2 and 42. The post-test means were 11.04 for experimental Group I, 11.08 for experimental Group II, and 10.84 for experimental Group III. The obtained "F" ratio 173.35 was higher than the table "F" ratio 3.21. Hence, the post-test mean "F" ratio was significant at 0.05 level of confidence for the degree of freedom 2 and 42. The adjusted post-test means were 11.04 for experimental Group I, 11.08 experimental Group II, and 10.84 for experimental Group III.

Table 1: Computation of ANCOVA of mean of CTG, WTG, and COTG on speed

Mean	CTG	WTG	COTG	Source of variance	Sum of squares	Df	Means squares	F-ratio
Pre-test means	7.11	7.24	7.15	BG	13.13	2	6.56	1.31
				WG	209.06	42	4.97	
Post-test means	6.97	7.00	6.78	BG	509.64	2	254.82	85.85*
				WG	124.66	42	2.96	
Adjusted post-test means	6.98	7.01	6.78	BG	516.02	2	258.01	92.42*
				WG	114.46	41	2.79	

CTG: Circuit training group, WTG: Weight training group, COTG: Combined training group, ANCOVA: Analysis of covariance. *Significant at 0.05 level of confidence

Table 2: The Scheffe's test for the differences between the adjusted post-test means on speed

Adjusted post-test means			Mean difference	Required CI
Circuit training	Weight training	Combined group		
6.98	7.01	-	0.03	0.19
6.98	-	6.78	0.20*	
-	7.01	6.78	0.23*	

*Significant at 0.05 level of confidence. CI: Confidence interval

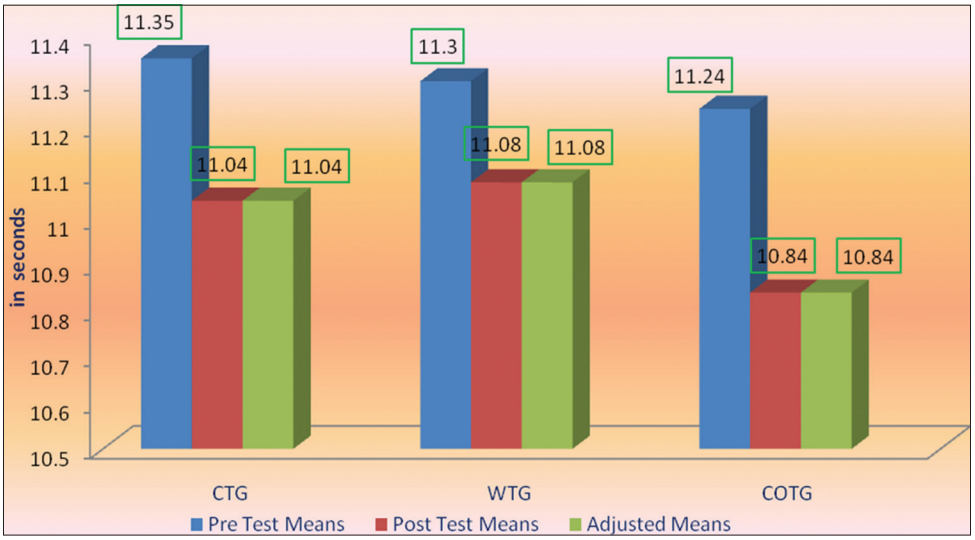

Figure 1: Adjusted post-test differences of the circuit training group, weight training group, and combined training group on speed

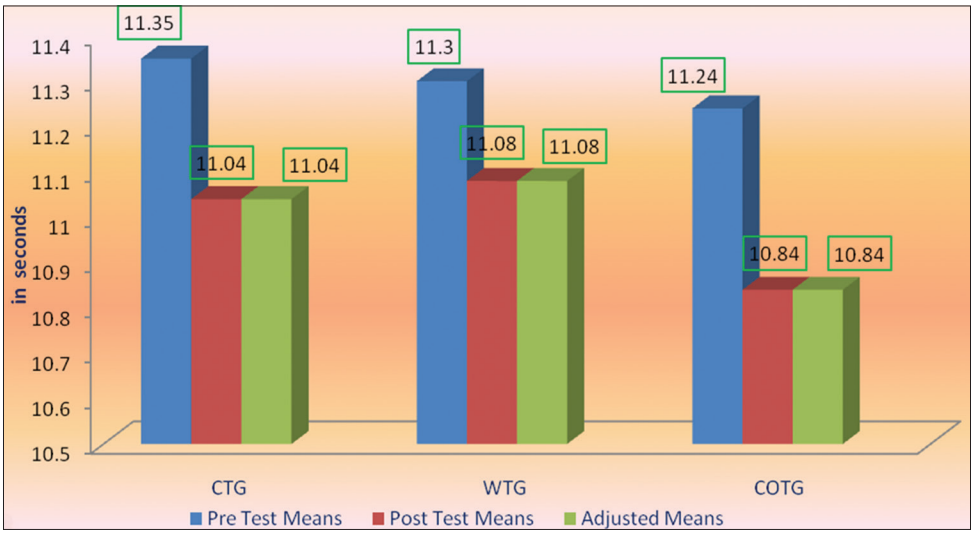

Figure 2: Adjusted post-test differences of the circuit training group, weight training group, and combined training group on agility

Table 3: Computation of analysis of covariance of mean of CTG, WTG, and COTG on agility

Mean	CTG	WTG	COTG	Source of variance	Sum of squares	Df	Means squares	F ratio
Pre-test means	11.35	11.30	11.24	BG	0.26	2	0.13	1.11
				WG	4.91	42	0.11	
Post-test means	11.04	11.08	10.84	BG	45.65	2	22.82	173.35*
				WG	5.53	42	0.13	
Adjusted post-test means	11.04	11.08	10.84	BG	41.70	2	20.85	174.10*
				WG	4.91	41	0.11	

CTG: Circuit training group, WTG: Weight training group, COTG: Combined training group. *Significant at 0.05 level of confidence

The obtained "F" ratio 174.10 was higher than the table "F" ratio 3.22. Hence, the adjusted post-test mean "F" ratio was significant at 0.05 level of confidence for the degree of freedom 2 and 41. It was concluded that there was a significant mean difference among CTG, WTG, and COTG, in developing the agility of hockey players [Figure 2].

Table 4 summarizes the *post hoc* analysis obtained on adjusted post-test means. The mean difference required for the confidential interval to be significant was 0.14. It was observed that the CTG significantly improved better agility than the combined group. It was also noted that the combined training group significantly improved agility better than the other groups.

Table 4: The Scheffe's test for the differences between the adjusted post-test means on agility

Adjusted post-test means			Mean difference	Required CI
Circuit training	Weight training	Combined group		
11.04	11.08	-	0.04	0.14
11.04	-	10.84	0.20*	
-	11.08	10.84	0.24*	

*Significant at 0.05 level of confidence. CI: Confidence interval

RESULT

The combined group produced significant improvement on selected physical fitness variables than weight training and combined training.

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