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EFFECT OF CIRCUIT TRAINING AND ANAEROBIC INTERVAL TRAINING ON SPEED AND STRENGTH AMONG MEN HANDBALL PLAYERS

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ABSTRACT

The purpose of the study was to find out the effect of circuit training and anaerobic interval training on speed and strength among men hand ball players. To archive this purpose of the study forty five college men hand ball players from Alagappa Chettiar Engineering College, Karaikudi, were randomly selected as subjects. The age of the subjects ranged between 21 to 25 years. The selected subjects were divided into three equal groups of fifteen subjects each. The experimental group 1(n=15) underwent Circuit training, the experimental group 2 (n = 15) underwent Anaerobic Interval training and control group 3 (n= 15) did not participate in any special training programme apart from their regular activities. All the subjects of three groups were tested on selected criterion variables such as speed and strength at prior to and immediately after the training programme by using 50mts run and push-ups respectively. Data for the selected variables were taken at the beginning (pre-test) and at the end of the experimental period (post-test). The Analysis of covariance (ANCOVA) was used for interpreting the results. On the basis of the results the circuit and anaerobic interval training has significantly contributed to the improvement of the selected dependent variables speed and strength.

KEYWORDS: Circuit Training, Anaerobic Interval Training, Speed, Strength

INTRODUCTION

Circuit training was developed by R.E. Morgan and G.T. Anderson in 1953 at the University of Leeds in England (Sorani, 1966). The term circuit refers to a number of carefully selected exercises arranged consecutively. In the original format, 9 to 12 stations comprised the circuit. This number may vary according to the design of the program (See Table 2 for an example circuit format). Each participant moves from one station to the next with little (15 to 30 seconds) or no rest, performing a 15- to 45-second workbout of 8 to 20 repetitions at each station (using a resistance of about 40% to 60% of one-repetition maximum). The program may be performed with exercise machines, hand-held weights, elastic resistance, calisthenics or any combination. By adding a 30-second to 3-minute (or longer) aerobics station between each station, referred to as aerobic circuit training, the method attempts to improve cardiorespiratory endurance as well. (Kravitz 1996; Taşkin, 2009).

The last few decades has seen the introduction of interval training which has had considerable influence on sports conditioning. Interval training involves alternating periods of work and rest during a training session. It is a program that varies the intensity within the training session by interspersing a work bout of a higher intensity with a rest period of lower intensity; then another work bout is completed, once again followed by a rest period, and so on through the workout. This method of

training is credited to Woldemer Gerschler of Germany who pioneered it around 1930 (Stone & Kroll, 1986). The premise of interval training is that an individual can produce a greater amount of work in a training session if the work bouts are spaced between periods of rest or relief. For instance, a highly motivated athlete may be able to maintain near maximal intensity exercise for 10 minutes before becoming too exhausted to continue. Yet, if the athlete were to work at near maximal intensity for 3 minutes interspersed with 3 minute recovery periods the pace may be maintained for an hour before experiencing the same degree of fatigue (MacDougall & Sale, 1981). Manipulating the length of the work and rest intervals in interval training will designate which energy systems are being overloaded. By adding a 30-second to 3-minute (or longer) aerobics station between each station, referred to as aerobic circuit training, the method attempts to improve cardio respiratory endurance as well.

BENEFITS OF CIRCUIT TRAINING (KRAVITZ 1996)

Numerous investigations have been completed measuring the physiological benefits of circuit weight training. Circuit weight training has been shown to increase muscular strength from 7% to 32% while decreasing the percent of fat from 0.8% to 2.9% (Gettman & Pollock, 1981). Gettman and Pollock's review of the literature also showed an increase of fat-free weight (1 to 3.2 kg) with no subsequent change in body weight. Kilocalorie expenditure has been estimated to be approximately 5 - 6 kcal per minute for women and 8 - 9 kcal per minute for men (Hempel & Wells, 1985; Wilmore, Parr, & Ward, 1978). In terms of cardiovascular function, studies have shown little to mild improvement in aerobic capacity (5% to 9.5%) from participation in circuit weight training as compared to other aerobic modalities (5% to 25%) (Kass & Castriotta, 1994; Peterson, Miller, Quinney, & Wenger, 1988). Kass and Castriotta support the contention that the mild increases in aerobic capacity are due primarily to increases in fat-free mass from the circuit weight training, and not changes from the main factors affecting aerobic capacity: cardiac output (heart rate x stroke volume) or arterial-venous oxygen difference (exchange of oxygen and carbon dioxide at the cellular level).

Traditionally, individuals with cardiovascular disease and hypertension have been discouraged from performing any type of resistance exercise. However, circuit training performed at a moderate intensity (40% of repetition maximum) in cardiac patients has demonstrated significant increases in strength (13% to 40%), with no cardiac or orthopedic complications (Kelemen et al., 1986; Stewart, Mason, & Kelemen, 1988). Furthermore, circuit weight training does not appear to elevate resting blood pressure or heart rate, and may beneficially lower resting diastolic blood pressure in borderline hypertensives (Harris & Holly, 1987).

Very little information is available on the psychological benefits of participation in circuit weight training. However, with law enforcement officers positive changes in mood, anxiety, depression and hostility have been observed (Norvell & Belles, 1993).

BENEFITS OF INTERVAL TRAINING (KRAVITZ 1996)

Maximal cardiac output, the maximal amount of blood the heart can pump in one minute is the product of heart rate and stroke volume (blood volume ejected by the heart per beat). Since maximal heart rate does not increase with training, changes in cardiac output are due to changes in stroke volume. It should be noted that maximal stroke volume is reached at

approximately 40% to 50% of VO2 max (Fontera & Adams, 1986). The heart's response to interval training is somewhat analogous to the muscle's response to the overload of resistance training. In resistance training, the muscle responds to the load of the weight and the total number of repetitions performed (repetitions X sets). In interval training, the resistance the heart overcomes is related to greater ventricular filling from enhanced venous return, and greater contractility leading to more complete emptying. Theoretically, an advantage of interval training is its ability to intermittently overload the heart for a brief period of time beyond which could be achieved during a single continuous bout at the same intensity. Similar to total repetitions in resistance training (where rest periods are interspersed between sets), the alternating work and relief intervals in interval training are proposed to allow for more cardiovascular work to be accomplished in the training session.

The high intensity work bouts of interval training may also help train the fast-twitch motor units, as well as the slow-twitch motor units, enhancing the anaerobic and aerobic energy systems. This may lead to more effective utilization of fats and carbohydrates. Another proposed benefit of interval training is that it improves the muscles' buffering capacity (a substance's capability of neutralzing both acids and bases), thus delaying the onset of fatigue due to the accumulation of lactate during anaerobic exercise (Wilmore & Costill, 1988). Other cardiorespiratory changes realized with interval (and continuous training) include an increase in muscle capillary density, an increase in myoglobin (the oxygen carrying protein in muscle), an increase in mitochondrial enzyme activity, and an increase in mitochondria size and/or number (MacDougall & Sale, 1981)

METHODOLOGY

The purpose of the study was to find out the Effect of circuit training and anaerobic interval training on speed and strength among men hand ball players. To archive this purpose of the study forty five college men Volley ball players from Alagappa Chettiar Engineering College Karaikudi, were randomly selected as subjects. The age of the subjects ranged between 21 to 25 years. The selected subjects were divided into three equal groups of fifteen subjects each. The experimental group 1 (n 15) underwent circuit training, the experimental group 2 (n 15) underwent anaerobic Interval training and control group-3 (n15) did not participate in any special training programme apart from their regular activities. The experimental groups were subjected to the training during morning hours for three days for six weeks. The circuit training and anaerobic interval training was selected as independent variables and the selected criterion variables such as speed and strength at prior to immediately after the training programme by using 50mts run and push-ups respectively. The experimental design selected for this study was pre and post test randomized design. The data were collected from each subject before and after the training period and statistically analyzed by using analysis of covariance (ANCOVA).

ANALYSIS OF DATA

The influence of Circuit training and anaerobic interval training on each variable was analyzed separately and presented below.

RESULTS AND DISCUSSIONS

SPEED

Table 1 shows the analyzed data on speed. The pre-test means of speed were 7.118 for experimental group 1, 7.118

for experimental group 2 and 7.119 for control group. The obtained "F" ratio was 0.12. The post-test means of speed were 7.066 for experimental group 1, 7.048 for experimental group 2 and 7.117 for control group. The obtained "F" ratio was 12.984 was higher than the table F-ratio 3.35. The adjusted post-test means of speed were 6.066 for experimental group 7.049 for experimental group 2 and 7.166 for control group. The obtained "F" ratio of 18.672 was higher than the table F-ratio value of 3.37.

Since, the analysis of covariance result was significant; to find out the pair wise comparison Scheffe's post hoc test was conducted. The results are presented in table 2.

Table 2 shows the Scheffe's Post-Hoc test results. The ordered adjusted final mean difference for speed of experimental groups 1, 2 and control group were tested for significance at 0.05 level of confidence against confidential interval value. The mean differences between experimental group 1 and experimental group 2, experimental group 1 and control group and experimental group 1 and control group were 0.017, 0.050 and 0.067 respectively. The confidence interval required to be significant was 0.040. Due to circuit and anaerobic interval training speed significantly improved whereas no improvement was seen in control group. However as there is significant difference between experimental group 1 and 2 in favour of anaerobic interval training, it is found that circuit and anaerobic interval training is superior in developing speed.

Table 1: Analysis of Covariance of Pre-Test Post Test and Adjusted Post Test on Speed of Different Groups (Scores in Seconds)

	Experimental Group 1	Experimental Group 2	Control Group	Source of Variance	Sum of Squares	Degrees of Freedom	Mean Squares	F
Pre test mean	7.118	7.118	7.119	Between	0.0002	2	0.0001	0.012
				Within	0.5860	42	0.0051	
Post test mean	7.066	7.048	7.117	Between	0.1679	2	0.0560	12.984*
				Within	0.5000	42	0.0043	
Adjusted post test mean	7.066	7.049	7.116	Between	0.1653	2	0.0551	18.672*
				Within	0.3394	41	0.0030	

* Significant at .05 level of confidence**.**

Table 2: Scheffe's Post Hoc Test Mean Differences on Speed among Three Groups (Scores in Seconds)

Experimental Group I	Experimental Group II	Control Group	Mean Differences	Confidence Interval Value
7.066	7.049	-	0.017	0.040
7.066	-	7.116	0.050*	0.040
-	7.049	7.116	0.067*	0.040

***** Significant at .05 level of confidence.

STRENGTH

Table 3 shows the analyzed data on strength. The pre-test means of strength were 19.1 for experimental group 19.7 for experimental group 2 and 19.8 for control group. The obtained "F" ratio was 0.621. The post-test means of speed were 21.1 for experimental group 1, 22.9 for experimental group 2 and 19.9 for control group. The obtained "F" ratio was 13.944 was higher than the table F-ratio 3.35. The adjusted post-test means of speed were 21.34 for experimental group 22.81 for experimental

group 2 and 19.76 for control group. The obtained "F" ratio of 24.312 was higher than the table F-ratio value of 3.37.

Since, the analysis of covariance result was significant; to find out the pair wise comparison Scheffe's post hoc test was conducted. The results are presented in table 2.

Table 4 shows the Scheffe's Post-Hoc test results. The ordered adjusted final mean difference for strength of experimental groups 1, 2 and control group were tested for significance at 0.05 level of confidence against confidential interval value. The mean differences between experimental group 1 and experimental group 2, experimental group 1 and control group and experimental group 1 and control group were 1.47, 1.58 and 3.05 respectively. The confidence interval required to be significant was 1.44. Due to circuit and anaerobic interval training strength significantly improved whereas no improvement was seen in control group. Hence it is found out that both circuit training and anaerobic interval training are equally good to develop strength.

Table 3: Analysis of Covariance of Pre-Test Post Test and Adjusted Post Test on Strength of Different Groups (Scores in Numbers)

	Experimental Group 1	Experimental Group 2	Control Group	Source of Variance	Sum of Squares	Degrees of Freedom	Mean Squares	F
Pre test mean	19.10	19.70	19.80	Between	2.87	2	1.43	0.621
				Within	96.60	42	2.3	
Post test mean	21.10	22.90	19.90	Between	45.60	2	22.80	13.944*
				Within	68.70	42	1.635	
Adjusted post test mean	21.34	22.81	19.76	Between	46.63	2	23.315	24.312*
				Within	40.28	42	0.959	

* Significant at .05 level of confidence.

Table 4: Scheffe's Post Hoc Test Mean Differences on Strength among Three Groups (Scores in Numbers)

Experimental Group I	Experimental Group II	Control Group	Mean Differences	Confidence Interval Value
21.34	22.81	-	1.47*	1.44
21.34	-	19.76	1.58*	1.44
-	22.81	19.76	3.05*	1.44

* Significant at .05 level of confidence.

CONCLUSIONS

Circuit and anaerobic interval training develop speed and strength of college handball ball players. When compared anaerobic interval training is superior to circuit training in the development of speed.

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