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Isolated and combined strength and endurance training induced adaptation on selected body composition variables among university players

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Abstract
The purpose of the study was to investigate the effects of isolated and combined strength and endurance training induced adaptation on selected body composition variables among university players. Sixty university players selected as a subjects from the Department of Physical Education and Sports Sciences, Annamalai University. The age, height and weight of the subjects ranged from 19 to 22 years, 158 to 166 centimeters and 55 to 65 kilograms respectively. The selected subjects were randomly assigned into four equal groups of 15 subjects each. Strength training group – I, endurance training group – II, combined strength and endurance training group – III and control group – IV. The collected data analyzed by analysis of covariance (ANCOVA). When the obtained 'F' ratio value was significant the Scheffe's test was applied as post hoc test. The result of the study revealed that twelve weeks of isolated and combined strength and endurance training reduced of body mass index, and percent body fat.

Keywords: Body Composition,Body mass index, percent body fat and combined training

1. Introduction

The human body consists of several components including fat mass, lean muscle mass, skeletal bone mass and total body water. The proportions of each of these components have important implications for present and future health as well as sports outcomes. Stronger muscles improve performance in a variety of sports. Sport-specific training routines are used by many competitors. These often specify that the speed of muscle contraction during weight training should be the same as that of the particular sport.

Endurance is a term widely used in sport and can mean many different things to many different people. In sports it refers to an athlete's ability to sustain prolonged exercise for minutes, hours, or even days. Endurance requires the circulatory and respiratory systems to supply energy to the working muscles in order to support sustained physical activity. High level endurance athletes often have a higher proportion of slow twitch muscle fibers. These slow twitch fibers are more efficient at using oxygen to generate more fuel for continuous, extended muscle contractions over a long time.

Kraemer and fleck (2004) suggest that strength and endurance training programs with a moderate amount of volume seem to be compatible with no deleterious effects on either strength or endurance. As the volume increases to that adopted by elite athletes, detriments in strength are more likely to occur. In many of the sports, combination of strength and endurance training is required to improve the performance and reduce the body fat. Therefore the researcher selected this study to find out which training alone induces more adaption on body composition variables.

2. Methodology

Subjects and Variables

The purpose of the study was to investigate the effects of isolated and combined strength and endurance training induced adaptation on selected body composition variables among university players. Sixty university players selected as a subjects from the Department of Physical Education and Sports Sciences, Annamalai University. The age, height and weight of the subjects ranged from 19 to 22 years, 158 to 166 centimetres and 55 to 65 kilograms respectively. The selected subjects were randomly assigned into four equal groups of 15 subjects each. Strength training group – I, endurance training group – II, combined strength and endurance training group – III and control group – IV. The selected body composition variables such as percent body fat assessed by skinfold calliper and body mass index assessed by using the following formula.

$$BMI = \frac{\text{Weight (kg)}}{\text{Height (metres)}^2} \text{ kg/m}^2$$

Training Protocol

The experimental groups performed the strength training, endurance training and combined strength and endurance training programs. Three sessions per week on alternative days for 12 weeks. The strength training program was a total body workout consisting of 3 sets of 6-10 repetitions on 8 exercises that trained all the major muscle groups. A percentage of each subject's one-repetition maximum for each exercise was used to determine the intensity of each week. The intensity and number of repetitions performed for each exercise changed once in two weeks. The endurance training consists of 20-40 minutes running 2-3 times per week with 65% HRR. The running intensity was determined by a percentage of heart rate reserve (HRR). The duration of each session were increased once in two weeks as training progressed. The combined strength and endurance training group underwent the both training schedule for three days per week and per day two sessions (morning and evening).

Experimental Design and Statistical Technique

The data collected from the two groups prior to and post experimentation on selected dependent variables were statistically analyzed to find out the significant difference if any, by applying the analysis of covariance (ANCOVA). When the obtained 'F' ratio value was significant the Scheffe's test was applied as post hoc test to determine the paired mean differences, if any. In all the cases statistical significance was fixed at 0.05 levels.

3. Results

Table 1: Analysis of Covariance on Body Mass Index of Experimental Groups and Control Groups

	Strength training	Endurance training	Combined Strength and Endurance training	Control Group	SOV	Sum of Squares	df	Mean squares	'F' ratio
Pre test Mean	27.14	27.56	27.38	27.40	B	0.74	3	0.24	0.09
SD	1.81	1.51	1.82	1.35	W	153.72	56	2.75	
Post test Mean	25.58	24.42	25.12	27.64	B	86.54	3	28.84	10.30*
SD	1.54	1.51	1.66	1.93	W	156.76	56	2.79	
Adjusted Post test Mean	25.66	24.34	25.13	27.64	B	89.16	3	29.72	13.79*
					W	118.49	55	2.15	

*Significant at 0.05 level of confidence

Table 2: Scheffe's Test for The Difference between the Adjusted Post Test Paired Means of Body Mass Index

Adjusted Post Test Means				DM	CI
Strength Training	Endurance Training	Combined Strength and Endurance Training	Control Group		
25.66	24.34			1.32	1.54
25.66		25.13		0.53	1.54
25.66			27.64	1.98*	1.54
	24.34	25.13		0.79	1.54
	24.34		27.64	3.30*	1.54
		25.13	27.64	2.51*	1.54

Table 3: Analysis of Covariance on Percent Body Fat of Experimental Groups and Control Groups

	Strength training	Endurance training	Combined Strength and Endurance training	Control Group	SOV	Sum of Squares	df	Mean squares	'F' ratio
Pre test Mean	16.64	16.74	16.69	16.85	B	0.37	3	0.12	0.02
SD	2.33	2.36	2.43	2.18	W	304.63	56	5.44	
Post test Mean	14.88	13.78	14.45	16.44	B	57.46	3	19.15	5.78*
SD	1.91	1.45	1.23	2.44	W	185.61	56	3.31	
Adjusted Post test Mean	14.93	13.77	14.46	16.37	B	54.47	3	18.15	9.69*
					W	103.05	55	1.87	

*Significant at0 .05 level of confidence

Table 4: Scheffe's Test for the Difference between the Adjusted Post Test Paired Means Of Percent Body Fat

Adjusted Post Test Means				DM	CI
Strength Training	**Endurance Training**	**Combined Strength and Endurance Training**	**Control Group**		
14.93	13.77			1.16	1.43
14.93		14.46		0.47	1.43
14.93			16.37	1.44*	1.43
	13.77	14.46		0.69	1.43
	13.77		16.37	2.60*	1.43
		14.46	16.37	1.91*	1.43

4. Discussion and Conclusions

Resistance and aerobic training favouring an increase in fat-free mass and a decrease in the percentage of body fat (Hakkinen et al., 2003); (Williams, et al., 2002); (Knapik, 1997). According to (Fleck and Kraemer, 2004) with regard to body composition, resistance training can increase lean body mass and decrease body fat levels. All three groups' strength training, endurance training and combined training groups decreased body fat over the 10 wk of training, and only the ET and CT groups reduced body fat mass (Melby, et al., 1993). Gaining of strength and muscle mass from strength training, also while gaining muscle endurance from the endurance training. The combination of strength and endurance training will lead to more lean muscle mass and less body fat. The researchers found from the result of the study combined strength and endurance training is better than the strength training or endurance training alone to reduce the body mass index and percent body fat.

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