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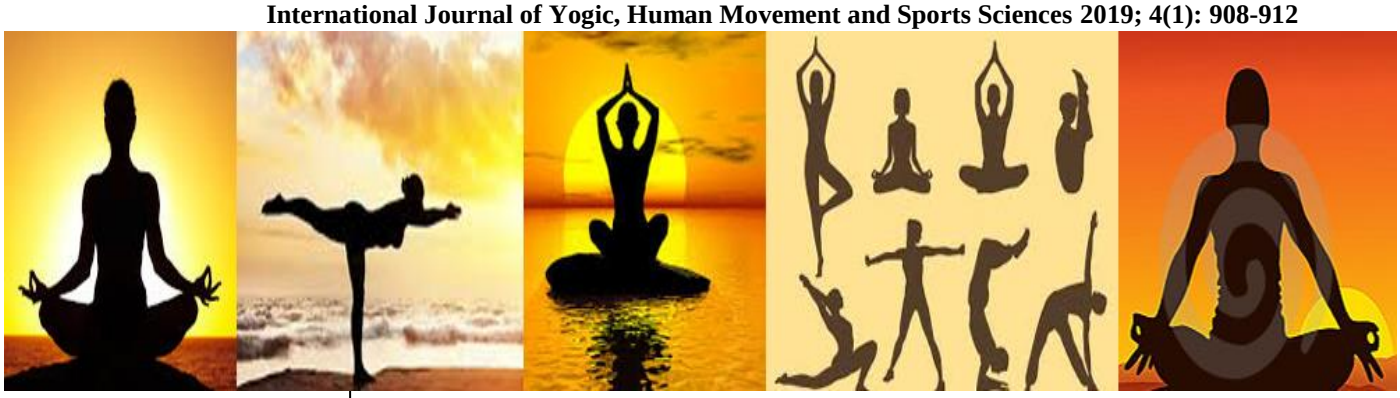

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Isolated and combined effect of aerobic training and circuit training on selected motor ability components among women volleyball players

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Abstract
The purpose of the study was to analyze the effect of isolated and combined aerobic training and circuit training on selected motor ability components among women volleyball players. To achieve the purpose of the study, sixty female students studying at various colleges at Kalasalingam Educational Institutions, Krishnankoil, Tamil Nadu, were selected as subjects. All of them were intercollegiate level volleyball players and their age ranged from 18 to 25 years. The selected subjects were randomly assigned into four equal groups of fifteen each (n=15) at random. Group-I underwent aerobic training, group-II underwent circuit training, group-III underwent combined aerobic and circuit training and group-IV acted as control group. The motor ability components were selected as flexibility, muscular strength, muscular endurance and they were assessed by sit and reach test, modified push ups and bend knee sit ups respectively. The data collected from the four groups prior to and post experimentation were statistically analyzed by Analysis of Covariance (ANCOVA). Since four groups were involved, whenever obtained 'F' ratio for adjusted post test means was found to be significant, the Scheffe's test was applied as post hoc test to determine the paired mean differences. The experimental groups had significant improvement on selected motor ability components when comparing to the control group.

Keywords: Aerobic training, circuit training, flexibility, muscular strength and muscular endurance

Introduction
Aerobic training is a physical exercise of low to high intensity that depends primarily on the aerobic energy-generating process. "Aerobic" means "relating to, involving, or requiring free oxygen", (Kenneth, 1997) [2] and refers to the use of oxygen to adequately meet energy demands during exercise via aerobic metabolism. Generally, light-to-moderate intensity activities that are sufficiently supported by aerobic metabolism can be performed for extended periods of time (Sharon and Denise, 2007) [5]. What is generally called aerobic exercise might be better termed "solely aerobic", because it is designed to be low-intensity enough so that all carbohydrates are aerobically turned into energy.

Circuit training is a form of body conditioning or endurance training or resistance training using high-intensity. It targets strength building or muscular endurance. An exercise "circuit" is one completion of all prescribed exercises in the program. When one circuit is complete, one begins the first exercise again for the next circuit. Traditionally, the time between exercises in circuit training is short, often with rapid movement to the next exercise (Comyns, 2018) [1].

A motor skill is a learned ability to cause a predetermined movement outcome with maximum certainty. Motor learning is the relatively permanent change in the ability to perform a skill as a result of practice or experience. Performance is an act of executing a motor skill. The goal of motor skills is to optimize the ability to perform the skill at the rate of success, precision, and to reduce the energy consumption required for performance. Continuous practice of a specific motor skill will result in a greatly improved performance, but not all movements are motor skills.

Volleyball drills are specialized exercises that enhance teams and players volleyball skills. There are numerous volleyball drills that teams and players can utilize in order to improve and further develop their skills in all areas of the game such as passing,

serving, attacking, setting, blocking and digging. From beginners to well-seasoned players, drills can help all players gain repetitions in various skills and positions; the more repetitions, the better a player can become.

Methodology

Selection of Subjects

The aim of the study was to analyze the isolated and combined effect of aerobic training and circuit training on selected motor ability components among women volleyball players. Sixty female students studying at various colleges of Kalasalingam Educational Institutions, Krishnankoil, Tamil Nadu, were selected as subjects to accomplish the study and all of them were intercollegiate level volleyball players in the age from 18 to 25 years. The selected subjects were randomly assigned into four equal groups of fifteen each (n=15) at random. Group-I underwent aerobic training, group-II underwent circuit training, group-III underwent combined training and group- IV acted as control group. The experimental group I, II, III performed, aerobic raining, circuit training and combined aerobic, circuit training respectively and no specific training to control group on alternate days for a period of 12 weeks only in morning session in between 6.30 am to 8.00 am under the personal supervision of the researcher.

The motor ability components selected were flexibility, muscular strength and muscular srength and endurance and they were assessed by sit and reach test, modified push ups and bend knee sit ups respectively.

Training Programme

Group-I, II & II subjects underwent their respective training programme for three days a week for twelve weeks. The intensity of training started from 50% to 70% of heart reate reserve (HRR). The training load progressively increased once in two weeks for 5%, the duration of aerobic training from 35 minutes to 45 minutes.

The aerobic exercises selected for experimental group-I were basic step, turn step,

V step, A step, L step, side to side, basic straddle step, double step side, knee up, leg curl, side lunching, back lunching, step touch, kick forward, kick sideward, grapevine T step and intensity V jump. The experimental group-II performed the following exercises. They are squat jump, push-ups, burpee, sit ups, skipping, squat thrusts, speed skater lunches, and crunch. Totally eight stations fixed for the circuit training group. Each exercise done for 30 seconds and between the exercises 30 seconds rest for recovery. It was followed up to 4 sets of exercises.

Group-III followed the aerobic training and circuit training schedules in morning and evening respectively for three days per week for twelve weeks.

Statistical Technique

The data collected from the four groups prior to and post experimentation were statistically analyzed by analysis of covariance (ANCOVA) was represented in Table I. Since four groups were involved, whenever obtained 'F' ratio for adjusted post test means was found to be significant, the Scheffe's test was applied as post hoc test to determine the paired mean differences. The level of significant was fixed at 0.05 in all the cases.

Table 1: Analysis of Covariance on Flexibility of Experimental and Control Groups

Test	Aerobic Training	Circuit Training	Combined Training	Control Group	SOV	Sum of Squares	df	Mean Squares	'F' Ratio
Pre Test Mean SD	6.73	6.53	6.40	6.26	B	1.78	3	0.59	0.68
	1.16	1.06	1.12	1.03	W	67.2	56	1.20	
Post Test Mean SD	9.13	9.60	10.13	6.66	B	105.78	3	35.26	19.67*
	1.06	1.59	1.60	0.97	W	100.40	56	1.79	
Adjusted Post Test Mean	9.06	9.58	10.15	6.72	B	101.41	3	33.80	19.48*
					W	95.43	55	1.74	

(The required table value for significance at 0.05 level of confidence with degrees of freedom 3 and 55 is 2.77 and degree of freedom 3 and 56 is 2.77) *Significant at 0.05 level of confidence.

The adjusted post test means on flexibility of aerobic training, circuit training, combined training groups and control groups are 9.06, 9.58, 10.15 and 6.72 respectively. The obtained 'F' ratio value of 19.48 on flexibility were greater than the required table value of 2.77 for the degrees of freedom 3 and 55 at 0.05 level of confidence. It is observed from this finding that significant differences exist among the adjusted post test means of experimental and control groups on flexibility.

Since, the adjusted post test 'F' ratio value is found to be significant the Scheffe's test is applied as post hoc test to determine the paired mean differences, and it is presented in Table II.

Table 2: Scheffe's test for the difference between the adjusted post test paired means of flexibility

Adjusted Post Test Means				DM	CI
Aerobic Training	Circuit Training	Combined Training	Control Group		
9.06	9.58	-	-	0.52	0.98
9.06	-	10.15	-	1.09*	0.98
9.06	-	-	6.72	2.34*	0.98
-	9.58	10.15	-	0.57	0.98
-	9.58	-	6.72	2.86*	0.98
-	-	10.15	6.72	3.43*	0.98

*significant

Table II shows the Scheffe's test results that there are significant differences between the adjusted post tests means of aerobic training and combined training groups; aerobic training group and control group; circuit training and control groups: combined training groups and control group on flexibility. The results also stated that there are significant

differences between the adjusted post tests means of aerobic training and circuit training groups; circuit training and combined training groups on flexibility. Among the experimental groups combined training group had high impact to increase on flexibility of volleyball players.

The mean scores of pre test, post test and adjusted post test of aerobic training, circuit training, combined training and control groups on flexibility was depicted in Figure 1.

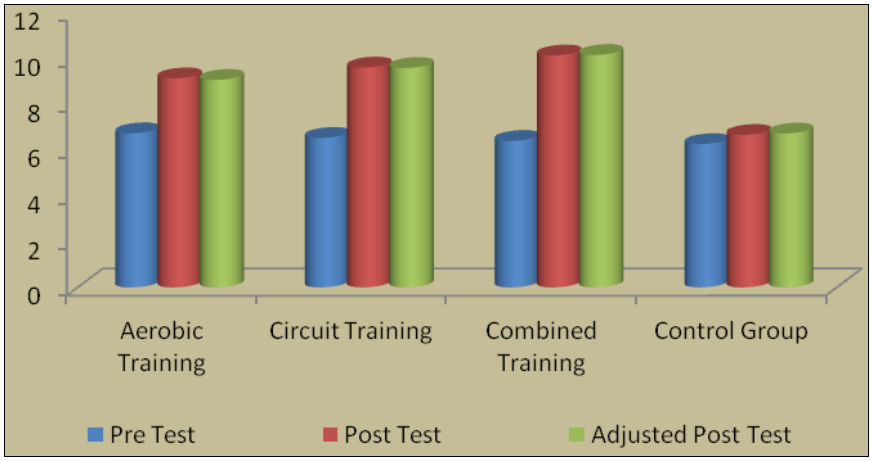

Fig 1: Mean scores of tests of aerobic training, circuit training, combined training and control groups on flexibility

Table 3: Analysis of covariance on muscular strength of experimental and control groups

Test	Aerobic Training	Circuit Training	Combined Training	Control Group	SOV	Sum of Squares	df	Mean Squares	'F' Ratio
Pre Test Mean SD	22.80	23.13	23.20	23.06	B	1.38	3	0.46	0.32
	1.14	1.24	1.15	1.22	W	79.46	56	1.41	
Post Test Mean SD	24.80	25.93	27.60	23.10	B	168.40	3	56.13	36.16*
	1.14	1.43	1.24	1.13	W	86.93	56	1.55	
Adjusted Post Test Mean	24.98	25.87	27.49	22.98	B	158.09	3	52.70	64.42*
					W	44.99	55	0.82	

(The required table value for significance at 0.05 level of confidence with degrees of freedom 3 and 55 is 2.77 and degree of freedom 3 and 56 is 2.77) *Significant at .05 level of confidence.

The adjusted post test means on muscular strength of aerobic training, circuit training, combined training groups and control groups are 24.98, 25.87, 27.49 and 22.98 respectively (Table 3). The obtained 'F' ratio value of 64.42 on muscular strength were greater than the required table value of 2.77 for the degrees of freedom 3 and 55 at 0.05 level of confidence. It is observed from this finding that significant differences exist among the adjusted post test means of experimental and control groups on muscular strength.

Since, the adjusted post test 'F' ratio value is found to be significant the Scheffe's test is applied as post hoc test to determine the paired mean differences, and it is presented in Table IV.

Table 4: Scheffe's test for the difference between the adjusted post test paired means of muscular strength

Adjusted Post Test Means				DM	CI
Aerobic Training	Circuit Training	Combined Training	Control Group		
24.98	25.87	-	-	0.89*	0.67
24.98	-	27.49	-	2.51*	0.67
24.98	-	-	22.98	2.00*	0.67
-	25.87	27.49	-	1.62*	0.67
-	25.87	-	22.98	2.89*	0.67
-	-	27.49	22.98	4.51*	0.67

***significant**

Table IV shows the Scheffe's test results that there are significant differences between the adjusted post tests means of aerobic training and circuit training groups; aerobic training and combined training groups; aerobic training group and control group; circuit training and combined training groups; circuit training and control groups: combined training group and control group on muscular strength. Among the experimental groups combined training group had high impact to increase on muscular strength of volleyball players.

The mean scores of pre test, post test and adjusted post test of aerobic training, circuit training, combined training and control groups on muscular strength was represented in Figure 2.

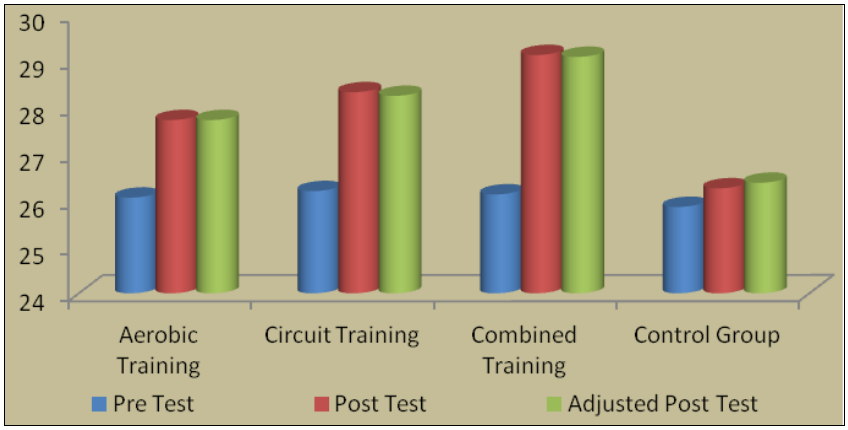

Fig 2: Mean scores of tests of aerobic training, circuit training, combined training and control groups on muscular strength

Table 5: Analysis of Covariance on Muscular Endurance of Experimental and Control Groups.

Test	Aerobic Training	Circuit Training	Combined Training	Control Group	SOV	Sum of Squares	df	Mean Squares	'F' Ratio
Pre Test	26.06	26.20	26.13	25.86	B	0.93	3	0.31	0.25
Mean SD	1.09	1.08	1.12	1.18	W	70.80	56	1.26	
Post Test	27.73	28.33	29.13	26.26	B	66.00	3	22.00	18.41*
Mean SD	1.03	0.97	1.30	1.04	W	66.93	56	1.19	
Adjusted Post	27.73	28.25	29.09	26.38	B	57.17	3	19.06	26.09*
Test Mean					W	40.17	55	0.73	

(The required table value for significance at 0.05 level of confidence with degrees of freedom 3 and 55 is 2.77 and degree of freedom 3 and 56 is 2.77) *Significant at .05 level of confidence.

The adjusted post test means on abdominal muscular strength and endurance of aerobic training, circuit training, combined training groups and control groups are 27.73, 28.25, 29.09 and 26.38 respectively (Table V). The obtained 'F' ratio value of 26.09 on abdominal muscular strength and endurance were greater than the required table value of 2.77 for the degrees of freedom 3 and 55 at 0.05 level of confidence. It is observed from this finding that significant differences exist among the adjusted post test means of experimental and control groups on abdominal muscular strength and endurance.

Since, the adjusted post test 'F' ratio value is found to be significant the Scheffe's test is applied as post hoc test to determine the paired mean differences, and it is represented in Table VI.

Table 6: Scheffe's Test for the difference between the adjusted post test paired means of muscular endurance.

Adjusted Post Test Means				DM	CI
Aerobic Training	Circuit Training	Combined Training	Control Group		
27.73	28.25	-	-	0.52	0.63
27.73	-	28.09	-	0.36	0.63
27.73	-	-	26.38	1.35*	0.63
-	28.25	28.09	-	0.16	0.63
-	28.25	-	26.38	1.87*	0.63
-		28.09	26.38	1.71*	0.63

*significant

Table VI shows the Scheffe's test results that there are significant differences between the adjusted post tests means of aerobic training group and control group; circuit training and control groups; combined training groups and control group on abdominal muscular strength and endurance. The results also stated that there are no significant differences between the adjusted post tests means of aerobic training and circuit training groups; aerobic training and combined training groups; circuit training and combined training groups on muscular strength and endurance. Among the experimental groups combined training group had high impact to increase on abdominal muscular strength and endurance of volleyball players.

The mean scores of pre test, post test and adjusted post test of aerobic training, circuit training, combined training and control groups on abdominal muscular strength and endurance was depicted in Figure 3.

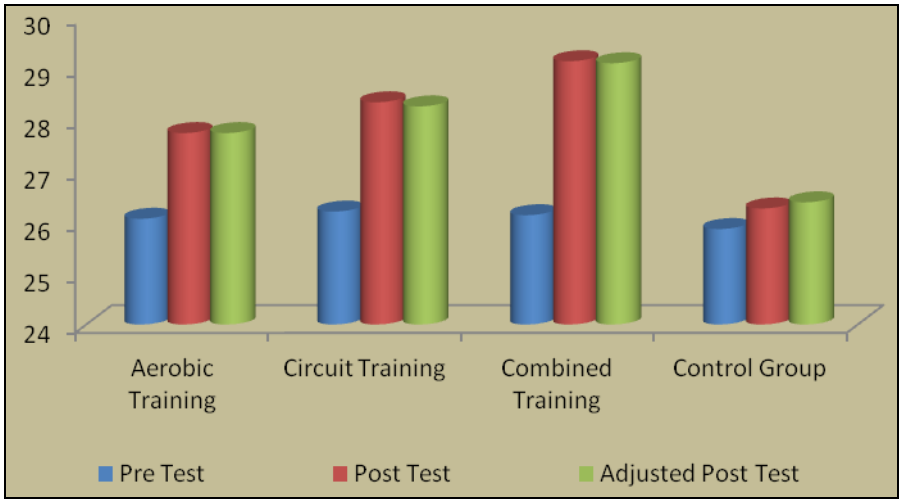

Fig 3: Mean scores of tests of aerobic training, circuit training, combined training and control groups on muscular endurance.

Discussion on Findings

The result of the study showed that the experimental groups had significant improvements on selected motor ability components such as flexibility, muscular strength and abdominal muscular strength and endurance when compared to control group due to twelve weeks training programme. Among the experimental groups combined training group had high impact to increase on motor ability components of volleyball players. The results of the study are in agreement with several reports. Shahana *et al*. (2010) [4] determined that combined strength and explosive training was better to improve muscular strength when comparing to the isolated training and also concluded that 12 weeks of aerobic training improved cardio respiratory endurance, flexibility, muscular strength endurance and decreased skin fold thickness (body fat %) among the experimental group of middle-aged women. Marques *et al*. (2011) [3] have described that aerobic exercise improves measures of physical performance such as gait speed and balance; resistance exercise was necessary to improve muscle strength. Randomised controlled trials of combined resistance and aerobic exercise interventions have demonstrated improvements in both PP and muscle strength.

Conclusion

The conclusion of the study showed that aerobic training, circuit training and combined training groups had significant increase on motor ability components such as flexibility, muscular strength and abdominal muscular strength and endurance when comparing to the control group due to twelve weeks of respective training programme of women volleyball players. Among the experimental groups combined training group had high impact to increase on motor ability components of volleyball players.

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