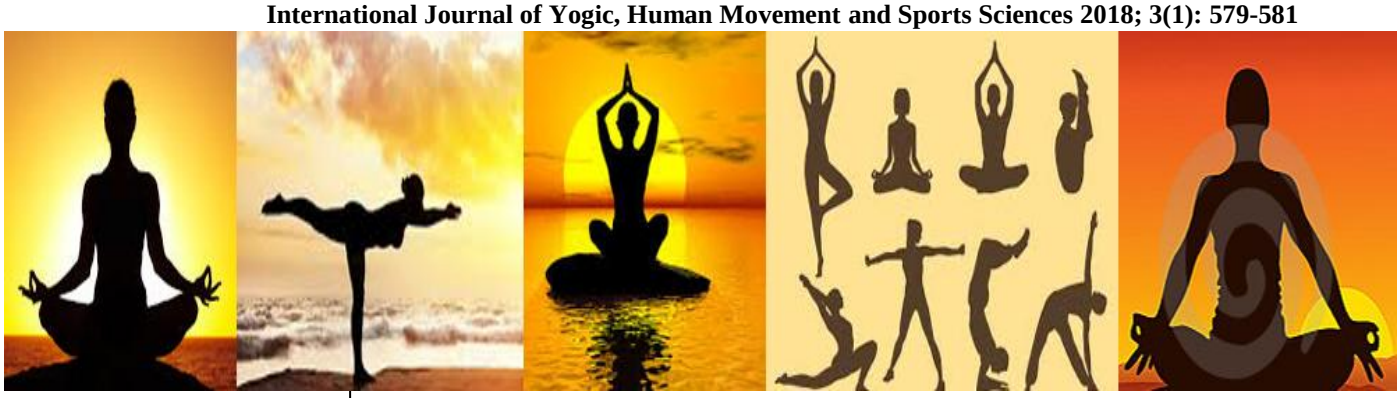
International Journal of Yogic, Human Movement and Sports Sciences 2018; 3(1): 579-581



ISSN: 2456-4419
Impact Factor: (RJIF): 5.18
Yoga 2018; 3(1): 579-581

www.theyogicjournal.com
Received: 21-11-2017
Accepted: 22-12-2017

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Physical fitness variables for speed, back strength and cardio respiratory endurance

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Abstract
The purpose of the study was to find out the effect of resistance training, and endurance training on selected physical fitness variables. (n=60) Sixty female students aged between 17 and 25 years were selected for the study. They were divided into three equal groups, each group consisting of (n=15) fifteen subjects in which Group I underwent resistance training, group II underwent endurance training three days per week for twelve weeks and group III acted as control, which did not participate in any training. The subjects were tested on selected criterion variables such as leg strength, back strength and cardio-respiratory endurance at prior to and immediately after the training period. For testing the speed measured by 50 meters dash and back strength, the dynamometer was used and to test the cardio-respiratory endurance, the Cooper's 12 minutes run/walk test was administered. The analysis of covariance (ANCOVA) was used to find out the significant difference if any, between the experimental groups and control group on selected criterion variables separately. Since there were four groups involved in the present study, the Scheffé *S* test was used as post-hoc test. The selected criterion variables such as speed, back strength and cardio-respiratory were improved significantly for all the training groups when compared with the control group and the leg and back strength were improved significantly for strength training group and in cardio-respiratory endurance, the endurance training group was significantly improved.

Keywords: Resistance training, endurance training, physical fitness, speed, back strength and cardio-respiratory endurance

Introduction
Training programmes are designed to improve performance by developing the appropriate energy sources, increasing muscular structures, and improving neuro-muscular skill patterns. Sports medicine professionals must be familiar with the basic principles and processes of training, so that they can evaluate training programmes and determine their adequacy in maintaining an athlete's health and preventing injury. Physical training is one of the most important ingredients in training to achieve high performance. The objectives of physical training are to increase the athlete's physiological potential and to develop biomotor abilities to the highest standards (Tudor O. Bompa, 1999) [16].

Sports training is a process of athletic improvement, which is conducted on the basis of scientific principles and which, through systematic development of mental and physical efficiency, capacity and motivation, enables the athletes to produce outstanding and record breaking athletic performances (Dietrich Harre, 1982) [5, 7]. While planning the dynamics of training, consider these aspects, referred to as the variables of training according to the functional and psychological characteristics of a competition. throughout the training phases preceding a competition, define which component to emphasize and achieve the planned performance objective (Vladimir M. Zatsiorsky, 1995) [17]. As we age we tend to lose lean muscle mass, which is a condition known as sarcopenia. Resistance training helps maintain and combat the loss of muscle mass by increasing muscular fitness. This form of training can also prevent osteoporosis by augmenting bone mineral density. What's more? Regular resistance training can decrease the risk of heart disease by lowering body fat, decreasing blood pressure, improving cholesterol, and lowering the stress placed on the heart while lifting a particular load. Improving muscular fitness is very important for enhancing quality of life. Resistance training can be accomplished with traditional free weights and dumbbells, weight

machines, body weight, elastic tubing, medicine balls, or even common household products like milk jugs filled with sand or soup cans. The choice to incorporate a certain type of resistance depends on level of physical fitness, how familiar a person is with specific exercise movements, and individual goals. For example, low fit individuals can focus primarily on machine-based exercises as they have been regarded as safer to use compared to more complex free weight exercises. The incorporation of free weight movements can be performed as a person increases his or her muscular fitness. For example, advanced individuals can perform multiple sets and heavier resistances using multiple-joint exercises, such as squats and deadlifts. Whichever form of resistance is chosen, multiple-joint, large muscle group exercises should be performed before single-joint, smaller group exercises.

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 training is the act of exercising to increase endurance. The termendurance training generally refers to training the aerobic system as opposed to the anaerobic system.

Speed is not just how fast someone can run (or cycle, swim etc.), but is dependent on their acceleration (how quickly they can accelerate from a stationary position), maximal speed of movement, and also speed maintenance (minimizing deceleration). Movement speed requires good strength and power, but also too much body weight and air resistance can act to slow the person down. In addition to a high proportion of fast twitch muscle fibers, it is vital to have efficient mechanics of movement to optimize the muscle power for the most economical movement technique.

Cardio respiratory endurance is a measurement of how well your heart, lungs, and muscles work together to keep your body active over an extended period of time. Exercisers can improve cardio respiratory endurance by participating in a program of regular aerobic exercise. Cardio-respiratory endurance is the ability to work close to one's maximum aerobic capacity for a prolonged period of time. To increase one's endurance is to depend upon increasing the ability to work at high, relative work load for extended periods of time.

Methods

In this study it was aimed to find out the effect of resistance training, and endurance training on leg strength, back strength and cardio-respiratory endurance. To achieve the purpose forty five female students from St. Micheal's College Cherthala, Kerala were selected as subjects at random from the total population of 159 students. They were divided into four equal groups of fifteen each and further divided as three experimental groups and one control group, in which the group I (n=15) underwent resistance training, group II (n = 15) underwent endurance training and group III (n = 15) underwent the combination training for three days per week for twelve weeks, and group IV (n=15) acted as control which did not participate in any special training apart from the regular physical education programme of the curriculum.

For every training programme there would be a change in various structure and systems in human body. So, the researchers consulted with the experts and then selected the following variables as criterion variables: 1. Speed, 2. Back strength and 3. Cardio-respiratory endurance.

Analysis of the Data

Analysis of covariance was used to determine the differences, if any, among the adjusted post test means on selected criterion variables separately. Whenever the 'F' ratio for adjusted post test mean was found to be significant, the Scheffé *S* test was applied as post-hoc test. The level of significance was fixed at. 05 level of confidence to test the 'F' ratio obtained by analysis of covariance.

Table 1: Analysis of Covariance and 'F' ratio for speed, Back Strength and Cardio-respiratory Endurance of Resistance Training Group, Endurance Training Group and Combined Training Group and Control Group

Variable Name	Group Name	Resistance Training Group	Endurance Training Group	Control Group	'F' Ratio
Speed	Pre-test Mean ± S.D	8.58 ± 0.049	8.68 ± 0.048	8.70 ± 0.022	0.36
	Post-test Mean ± S.D.	8.27 ± 0.043	8.40 ± 0.042	8.91± 0.049	11.33*
	Adj. Post-test Mean	8.390	8.488	8.889	31.54*
Back Strength	Pre-test Mean±S.D.	65.13 ± 1.552	64.47 ± 1.807	64.87 ± 2.356	0.654
	Post-test Mean±S.D.	71.93 ± 2.434	66.13 ± 2.10	63.71 ± 2.031	28.74*
	Adj. Post-test Mean	71.506	66.295	64.175	70.125*
Cardio-respiratory Endurance	Pre-test Mean±S.D.	1596.67 ± 45.93	1598.67 ± 68.02	1626.0 ± 73.659	1.167
	Post-test Mean±S.D.	1618.67 ± 41.73	1742.7 ± 59.217	1624.7 ± 71.0	18.40*
	Adj. Post-test Mean	1630.76	1753.17	1613.37	82.605*

* Significant at. 05 level of confidence. (The table value required for significance at. 05 level of confidence with df 3 and 56 and 3 and 55were 2.77 and 2.78 respectively).

Table – I shows that pre-test mean 'f ratio of resistance training sand group, endurance training group and control group on shoulder muscular strength was 2.30, which were insignificant at 0.05 level of confidence. The post test and adjusted post test mean 'f' ratio value of experimental groups and control group were 14.17 and 31.61, which was significant at 0.05 level of confidence. The pre test mean 'f ratio of resistance training group, endurance training group and control group on speed was 0.36, which was insignificant at 0.05 level of confidence. The post test and adjusted post-test means 'f' ratio value of experimental group and control group were 11.33 and 24.538, which was significant at 0.05 level of confidence. The pre test mean 'f ratio of resistance training group, endurance training group and control group on cardio-respiratory endurance was 1.167 which was not significant at 0.05 level of confidence. The post test and adjusted post test means 'f' ratio value of experimental groups and control group were 18.40 and 82.605, which was significant at 0.05 level of confidence. Further which of the paired Further to determine which of the paired means has a significant difference among the groups, the Scheffé *S* test was applied.

Adjusted Post-test Mean on Speed				
Resistance training Sand Group	**Endurance training Group**	**Control Group**	**Mean Difference**	**Confidence interval at. 05 level**
8.390		8.889	0.499*	0.159664
8.390	8.488		0.098	0.159664
	8.488	8.889	0.401*	0.159664
Adjusted Post-test mean for Back strength				
77.506	67.295		4.211*	2.8659
71.506		64.175	7.331	2.8659
	67.295	64.175	3.12*	2.8659
Adjusted Post-test mean for cardio respiratory endurance				
1630.76	1753.17		122.411	98.9795
1630.76		1613.37	17.39	98.9795
	1753.17	1613.37	139.8*	98.9795

* Significant at. 05 level of confidence.

Table – II shows that the Scheffe *S* Test for the difference between adjusted post-test mean on speed of resistance training sand group and control group (0.499) and endurance training group and control group (0.401), which were significant at. 05 level of confidence. There was a significant difference on shoulder muscular strength between resistance training sand group and control group (4.21) and endurance training group and control group (2.31) and also there was a significant difference on cardio-respiratory endurance between resistance training group and control group (117.39), resistance training group and endurance training group (122.41) and endurance training group and control group (239.80) which was significant at 0.05 level of confidence after the respective training programme. Moreover the result of the study shows that there was no significant difference between the training groups on shoulder muscular strength and speed. But the result of the study shows that endurance training group was better in cardio-respiratory endurance than the resistance training group.

Conclusions

1. There was a significant improvement in speed for resistance training group and endurance training group when compared with the control group. The result of the study also shows that there was no significant difference between the training groups on cardio-respiratory endurance.
2. The result of the present study shows that there was a significant increase in shoulder muscular endurance for both the experimental groups when compared with the control group.

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