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Effect of Aerobic Training, Aquatic Training and Combined Training on Selected Physiological and Biochemical Variables among Obese College Men

KEYWORDS: aerobic training, aquatic training, Resting heart rate, maximum oxygen consumption, systolic blood pressure, diastolic blood pressure, high density lipoprotein, low density lipoprotein and triglycerides.

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ABSTRACT *We examined the effect of aerobic training, aquatic training and combined training on selected physiological and biochemical variables among obese college men. The 12- week -long exercise intervention included 60-min of moderate-to-vigorous aerobic training, aquatic training and combined training five times per week. The control group was not exposed to any of additional activity other than their routine. The study was formulated as a random group design. In this study, sixty college men age group of 18 to 21 years were selected as subjects. A pre and post test was employed for this investigation. The subjects were randomly divided into four groups (three experimental and one control group). Group I (n=15; AETG) had undergone aerobic training, group II (n=15; AQTG) had undergone aquatic training, group III (n=15; CTG) had undergone combined training and group IV (n=15; CG) as control. All the subjects were tested prior and after the 12 weeks training period. Results: The results reveal that the interventions had an impact on the selected variables to a similar degree in all experimental groups; it was observed that the mean gains and losses made from pre and post test were statistically significant showing that the group that practiced twelve weeks of aerobic training produced significant improvement in resting heart rate (-2.13, p<0.05), maximum oxygen consumption (+1.11,p<0.05), systolic blood pressure (-3.87,p<0.05), diastolic blood pressure (-2.80,p<0.05), high density lipoprotein (+4.15,p<0.05), low density lipoprotein (-10.69,p<0.05) and triglycerides (-16.64,p<0.05). Aquatic training produced significant improvement in resting heart rate (-3.20, p<0.05), maximum oxygen consumption (+1.35, p<0.05), systolic blood pressure (-2.00, p<0.05), diastolic blood pressure (-2.00, p<0.05), high density lipoprotein (+1.67, p<0.05), low density lipoprotein (-6.50, p<0.05) and triglycerides (-8.78, p<0.05). Combined training produced significant improvement in resting heart rate (-3.07, p<0.05), maximum oxygen consumption (+1.54,p<0.05), systolic blood pressure (-2.93,p<0.05), diastolic blood pressure (-2.53,p<0.05), high density lipoprotein (+3.15,p<0.05), low density lipoprotein (-5.25,p<0.05) and triglycerides (-8.89, p<0.05). Control group produced insignificant improvement in resting heart rate (-0.27, p>0.05), maximum oxygen consumption (+0.01, p>0.05), systolic blood pressure (-0.13, p>0.05), diastolic blood pressure (-0.27, p>0.05), high density lipoprotein (+0.31, p>0.05), low density lipoprotein (+0.80, p>0.05) and triglycerides (+0.86, p>0.05).*

INTRODUCTION

Obesity is a major public health problem, due to both its rapid growth in recent decades and also the related health disorders, such as cardiovascular diseases, diabetes, certain forms of cancer, osteomuscular diseases and gall bladder disease, among others (WHO, 2000). Consequently, obesity is also associated with greater health-service use and higher general mortality (Roux and Donaldson, 2004). Obesity, now-a-days, is considered to be a disorder which leads to chronic diseases. Being overweight gives rise to many health problems.Overweight and obesity are prevalent worldwide, (Berghofer et al., 2008) exceeding 60% in the United States, (Ogden, 2006) and globally their rates are increasing (Aekplakorn et al., 2009 and Lahti et al., 2010). Aerobic Training (defined as the rhythmical contraction and relaxation of large muscle masses over an extended time) has been shown to improve physical performance and reduce fatigue in obese (Winningham and MacVicar, 1989). Aquatic training is used to effectively improve injured athletes, older population, autistic, obese, Although aquatic training may not improve these problems completely, it promotes normal tone, strength, increased mobility and flexibility, and improved proprioceptive and sensory stimulation (Aquatic exercise association, 2003). The buoyancy effect of water makes aquatic training an optimal exercise environment for overweight and obese individuals, as impact and stress on joints is reduced (Gappmaier et al., 2006). A very high interest surrounds muscle strength training, since several health-related benefits are obtained with this type of training programs in fitness and therapy contexts. Studies in the literature reported significant improvements after programs from 8 weeks (Colado et al. 2009b. Some of the most interesting researches assessed muscle strength with isokinetic machines (Tsourlou et al. 2006). In such cases, muscle strength improved 7 % and 10.5 % for knee extension and 13.4 % for knee flexion (Tsourlou et al. 2006). Moreover, at least one investigation suggests that aquatic resistance exercises, i.e., exercises performed in water using special devices, have the advantage of increasing training intensity (Colado et al. 2009a).

METHODOLOGY:

A survey was conducted to find out the obese male students between the age group of 18-21 years from Amrita Vishwa Vidyapeetham, Coimbatore, Tamilnadu. A total of 242 students were selected for the test and the height and weight of the students were measured. BMI was calculated by (Body mass index formula BMI = M / (H x H), where M = body mass in kilograms and H= height in meters). According to the National institutes of health, (1998) students with a BMI of 18.5 to 24.9 are considered to be of normal weight. Those with a BMI of 25.0 to 29.9 are overweight. Students with a BMI of 30.0 to 34.9 or 35.0 to 39.9 are in obesity class I or II, respectively; and those with a BMI of 40 and above were considered extremely obese (obesity class III). Among the 242 students, 57 students were of normal weight, 104 students were overweight and 81 students were obese.

From the obese category level 60 students were randomly selected and were further divided into four groups each of size 15 (n = 15), namely, group I, group II, group III, and group IV. Here group I had undergone aerobic training, group II had undergone aquatic training, group III had undergone combined training and group IV were the control group.

The study was formulated as a random group design. In

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this study, sixty college men who were found to be obese after a pilot study in the age group of 18 to 21 years were selected as subjects. A pre and post test was employed for this investigation. The subjects were randomly divided into four groups (three experimental and one control group). Group I (n=15; AETG) had undergone aerobic training, group II (n=15; AQTG) had undergone aquatic training, group III (n=15; CTG) had undergone combined training and group IV (n=15; CG) as control. All the subjects were tested prior and after the 12 weeks training period.

The present study was undertaken primarily to assess the effectiveness of aerobic training, aquatic training and combined training on selected physiological and biomechanical variables Physiological variables Resting heart rate, Maximum oxygen consumption, Systolic blood pressure, Diastolic blood pressure. Biochemical variables. High density lipoprotein, Low density lipoprotein, Triglycerides

Measurements:
Resting heart rate test was calculated by beats per minute by stopwatch. Maximum oxygen consumption, (VO_2 max) was calculated based on the raw scores obtained for cardio respiratory endurance by using the following formula: VO_2 max = (Distance covered in meters -504.9) / 44.73. The values are recorded in $ml.kg^{-1}.min^{-1}$ (Cooke et al., 2010). Systolic blood pressure and diastolic blood pressure was calculated by sphygmomanometer and stethoscope. High density lipoprotein, Low density lipoprotein and Triglycerides, in the blood sample of each subject which was recorded in mg /dl.

Training programme
During the training period, the experimental group underwent their training programme. The procedure adopted in the training programme for the present study is described in the following aspects.

Aerobic training group
This group underwent aerobic training program consists of the five different exercises. The subjects were asked to do aerobic training in every station with a rest between sets of 1 minute. Each exercise has been performed for 1 minute duration. In each station the subjects were asked to do particular repetitions according to the exercise. The subjects were asked to do 4 sets of the each exercise with the period of 8 minutes, including rest between sets. The subjects were asked to do 10 minutes of warming up, 40 minutes of aerobic exercises and 10 minutes of warm down exercises. The subjects underwent three different levels of intensities as low (1-4weeks), moderate (5-8weeks), high intensity (9-12weeks).

Aquatic training group
The subjects were asked to do the aquatic training in the swimming pool with the depth of waist level and the difficulty level of the exercise have been asked and they have been categorized in the same manner as did for aerobic training group. The subjects underwent three different levels of intensities as low (1-4weeks), moderate (5-8weeks), high intensity (9-12weeks). Five aquatic exercises have been selected for the program. The subjects were asked to do 10 minutes of warming up, 40 minutes of aquatic exercises and 10 minutes of warm down exercises.

Combined training group
The subjects were asked to do aerobic training and aquatic training which was followed by same exercise done by aerobic training group and aquatic training group during alternate weeks. First one week they followed aerobic training and joined with aerobic training group and performed the same exercise and next week they followed the aquatic training and joined with the aquatic training group and performed the same exercise. Aerobic training programme was followed during 1st, 3rd, 5th, 7th, 9th and 11th week. Aquatic training programme was followed during 2nd, 4th, 6th, 8th, 10th and12th week. Aerobic and aquatic training programmed was performed with low intensity level during (1st & 3rd, 2nd & 4th weeks), moderate intensity levels during (5th & 7th , 6th & 8th weeks), and high intensity levels during (9th & 11th, 10th & 12th weeks) respectively.

Exercises:
Aerobic training: (Step aerobics-V step: (Height-15 cm) , Two count jumping jack, High knee action, 16 count exercise, Side bend)

Aquatic training :(Alternate toe touch, Bounce, Side bender, Poolside knees up, supine, Front flutter kick)

Combined training group (had undergone aerobic training and aquatic training alternate weeks as follows: Aerobic training programme was followed in 1st, 3rd, 5th, 7th, 9th and 11th week respectively. Aquatic training programme was followed during 2nd, 4th, 6th, 8th, 10th and12th week respectively.)

Statistical Analysis Plan: To analyze the training effect of aerobic training group, aquatic training group, combined training group and control group t-test was used. The selected subjects of all the groups were tested on criterion variables. In order to compare the effects of treatment on physical fitness, physiological and biochemical variables among the four groups, analysis of covariance (ANCOVA) was used to find out the significant differences in each criterion variables among the groups.When the f-ratio was significant Scheffe's post hoc test was used to find out which treatment used in the present study is the source for the significance of adjusted post test means. All the statistical analysis tests were computed at 0.05 level of significance (p<0.05). SPSS 15.0 for windows evaluation version software was used to analyze the data.

Results:
TABLE 1
SIGNIFICANCE OF MEAN GAINS / LOSES BETWEEN PRE AND POST TEST OF AEROBIC TRAINING GROUP ON PHYSIOLOGICAL & BIOCHEMICAL VARIABLES

Variables	Pre test		Post test		M.D	SEM	't' ratio
	mean	±SD	mean	±SD			
Physiological variables							
Resting heart rate	75.87	±6.95	73.73	±5.44	2.13	0.66	3.23*
Maximum oxygen consumption	17.91	±2.93	19.02	±2.82	1.11	0.08	13.42*
Systolic blood pressure	122.53	±7.54	118.67	±7.04	3.87	0.24	16.36*
Diastolic blood pressure	75.87	±4.69	73.07	±3.37	2.80	0.58	4.84*
Biochemical variables							
High density lipoprotein	55.45	±6.82	59.60	±6.52	4.15	0.39	10.70*
Low density lipoprotein	134.07	±12.66	123.39	±11.50	10.69	0.80	13.30*
Triglycerides	154.86	±17.22	138.22	±14.54	16.64	1.26	13.26*
* Significant at 0.05 level Required table value 2.145							

Table 1 indicates that the obtained 't' ratio of aerobic training on physiological and biochemical variables were, resting heart rate (3.23), maximum oxygen consumption (13.42), systolic blood pressure (16.36), diastolic blood pressure (4.84), high density lipoprotein (10.70), low density lipoprotein (13.30), triglycerides (13.26). The obtained't' ratios on the above aerobic training on physiological and biochemical variables were greater than the critical value of 2.145 for degrees of freedom 14. It was observed that the mean gains and losses made from pre and post test were statistically significant showing that the group that practiced twelve weeks of aerobic training produced significant improvement in resting heart rate (-2.13, p<0.05), maximum oxygen consumption (+1.11,p<0.05), systolic blood pressure (-3.87,p<0.05), diastolic blood pressure (-2.80,p<0.05), high density lipoprotein (+4.15,p<0.05),low density lipoprotein (-10.69,p<0.05) and triglycerides (-16.64,p<0.05).

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TABLE 2
SIGNIFICANCE OF MEAN GAINS / LOSES BETWEEN PRE AND POST TEST OF AQUATIC TRAINING GROUP ON PHYSIOLOGICAL & BIOCHEMICAL VARIABLES

Variables	Pre test		Post test		M.D	SEM	't' ratio
	mean	±SD	mean	±SD			
Physiological variables							
Resting heart rate	77.87	±7.69	74.67	±5.74	3.20	0.67	4.77*
Maximum oxygen consumption	19.34	±4.50	20.69	±4.47	1.35	0.09	14.28*
Systolic blood pressure	123.47	±8.19	121.47	±6.65	2.00	0.76	2.65*
Diastolic blood pressure	78.13	±5.58	76.13	±5.04	2.00	0.44	4.58*
Biochemical variables							
High density lipoprotein	56.88	±5.80	58.55	±6.10	1.67	0.28	6.08*
Low density lipoprotein	129.01	±11.77	122.51	±10.67	6.50	0.61	10.65*
Triglycerides	145.31	±17.12	136.53	±16.23	8.78	0.84	10.40*

* Significant at 0.05 level
Required table value 2.145

Table 2 indicates that the obtained 't' ratio of aquatic training on physiological and biochemical variables were, resting heart rate (4.77), maximum oxygen consumption (14.28), systolic blood pressure (2.65), diastolic blood pressure (4.58), high density lipoprotein (6.08), low density lipoprotein (10.65), triglycerides (10.40). The obtained't' ratios on the above aquatic training on physiological and biochemical variables were greater than the critical value of 2.145 for degrees of freedom 14. It was observed that the mean gains and losses made from pre and post test were statistically significant showing that the group that practiced twelve weeks of aquatic training produced significant improvement in resting heart rate (-3.20,p<0.05), maximum oxygen consumption (+1.35,p<0.05), systolic blood pressure (-2.00,p<0.05), diastolic blood pressure (-2.00,p<0.05), high density lipoprotein (+1.67,p<0.05), low density lipoprotein (-6.50,p<0.05) and triglycerides (-8.78,p<0.05).

TABLE 3
SIGNIFICANCE OF MEAN GAINS / LOSES BETWEEN PRE AND POST TEST OF COMBINED TRAINING GROUP ON PHYSIOLOGICAL & BIOCHEMICAL VARIABLE

Variables	Pre test		Post test		M.D	SEM	't' ratio
	mean	±SD	mean	±SD			
Physiological variables							
Resting heart rate	76.00	±7.05	72.93	± 5.44	3.07	0.80	3.83*
Maximum oxygen consumption	17.17	±3.00	18.71	±2.98	1.54	0.05	30.99*
Systolic blood pressure	124.27	±8.58	121.33	± 7.16	2.93	0.75	3.90*
Diastolic blood pressure	78.53	±5.63	76.00	±4.54	2.53	0.53	4.75*
Biochemical variables							
High density lipoprotein	51.68	±6.20	54.83	±5.39	3.15	0.34	9.33*
Low density lipoprotein	132.31	±13.62	127.06	±13.09	5.25	0.62	8.50*
Triglycerides	147.95	±20.97	139.07	±18.31	8.89	0.95	9.32*

* Significant at 0.05 level
Required table value 2.145

Table 3 indicates that the obtained 't' ratio of combined training on physiological and biochemical variables were, resting heart rate (3.83), maximum oxygen consumption (30.99), systolic blood pressure (3.90), diastolic blood pressure (4.75), high density lipoprotein (9.33), low density lipoprotein (8.50), triglycerides (9.32). The obtained't' ratios on the above combined training on physiological and biochemical variables were greater than the critical value of 2.145 for degrees of freedom 14. It was observed that the mean gains and losses made from pre and post test were statistically significant showing that the group that practiced twelve weeks of combined training produced significant improvement in resting heart rate -3.07,p<0.05), maximum oxygen consumption (+1.54,p<0.05), systolic blood pressure (-2.93,p<0.05), diastolic blood pressure (-2.53, p<0.05), high density lipoprotein (+3.15,p<0.05), low density lipoprotein (-5.25,p<0.05) and triglycerides (-8.89, p<0.05).

TABLE 4

SIGNIFICANCE OF MEAN GAINS / LOSES BETWEEN PRE AND POST TEST OF CONTROL GROUP ON PHYSICAL FITNESS, PHYSIOLOGICAL & BIOCHEMICAL VARIABLES

Variables	Pre test		Post test		M.D	SEM	't' ratio
	mean	±SD	mean	±SD			
Physiological variables							
Resting heart rate	79.47	±6.16	79.20	±5.17	0.27	0.61	0.44
Maximum oxygen consumption	17.24	±2.45	17.25	±2.16	0.01	0.13	0.07
Systolic blood pressure	122.93	±4.40	122.80	±4.33	0.13	0.53	0.25
Diastolic blood pressure	77.07	±4.95	76.80	±4.59	0.27	0.61	0.44
Biochemical variables							
High density lipoprotein	52.09	±5.09	52.40	±5.02	0.31	0.24	1.32
Low density lipoprotein	137.42	±10.26	138.22	±9.85	0.80	0.56	1.42
Triglycerides	153.44	±15.51	154.30	±14.78	0.86	0.55	1.55

* Significant at 0.05 level
Required table value 2.145

Table 4 indicates that the obtained 't' ratio of control group on physiological and biochemical variables were, resting heart rate (0.44), maximum oxygen consumption (0.07), systolic blood pressure (0.25), diastolic blood pressure (0.44), high density lipoprotein (1.32), low density lipoprotein (1.42), triglycerides (1.55). The obtained't' ratios on the above control group on physiological and biochemical variables were lesser than the critical value of 2.145 for degrees of freedom 14. It was observed that the mean gains and losses made from pre and post test were statistically insignificant showing that twelve weeks practice of control group produced insignificant improvement in resting heart rate (-0.27, p>0.05), maximum oxygen consumption (+0.01, p>0.05), systolic blood pressure (-0.13, p>0.05), diastolic blood pressure (-0.27, p>0.05), high density lipoprotein (+0.31, p>0.05), low density lipoprotein (+0.80, p>0.05) and triglycerides (+0.86, p>0.05).

Conclusion:
Aerobic training group had shown significant reduction than aquatic training group, combined training group and control group in low density lipoprotein and triglycerides. Aerobic training group had significant improvement than the aquatic training and control group in high density lipoprotein. Aerobic training group is better than control group alone in

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resting heart rate, maximum oxygen consumption, systolic blood pressure and diastolic blood pressure. Aquatic training group showed significant improvement than the aerobic training group and control group in resting heart rate, maximum oxygen consumption, high density lipoprotein, low density lipoprotein, triglycerides. Aquatic training group had no significant reduction than control group in systolic blood pressure and diastolic blood pressure. Also aquatic training group had no significant changes compared to combined training group in all variables. Combined training group had significant improvement than the aerobic training group and control group in maximum oxygen consumption. Combined training group is better than control group alone in resting heart rate, systolic blood pressure, diastolic blood pressure, high density lipoprotein, low density lipoprotein and triglycerides. Also combined training group had no significant changes compared to aquatic training group in all variables.

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