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EFFECTS OF AEROBIC AND ANAEROBIC TRAINING ON STROKE VOLUME RESPONSES TO ACTIVE STRESS

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ABSTRACT

The study was proposed to examine the changes on stroke volume responses to active stress with aerobic and anaerobic training among untrained male university students. Forty-five untrained male university students, in the age group of twenty to twenty-five years were selected as participants, and they were segregated into three groups namely: control, aerobic and anaerobic training groups. The duration of experimentation period was restricted to twelve weeks and the frequency of training was thrice a week. The other independent variable confined to this study is aerobic exercise stress testing using Bruce treadmill protocol to evaluate its influence on stroke volume. The data on stroke volume were measured at rest and after exercise conditions from all the three groups, before and after twelve weeks of experimentation. The data thus collected was subjected to three-way factorial ANOVA with repeated measures on last two factors. The findings of the study revealed that the stroke volume at rest and after exercise conditions of aerobic and anaerobic training groups altered significantly for better as a result of respective training, where aerobic training has the upper hand as compared to anaerobic training for its effectiveness on stroke volume.

INTRODUCTION

Human beings acclimatize in a variety of ways depending upon the stresses to which it is exposed. Reactions to excessive stresses are modified by the individual attributes of each person. The length of exposure to stresses modifies the nature of changes and the resiliency of those changes. Thus, upon exposure to an active stress, the body undergoes a hierarchy of responsive changes, the physiological and biochemical changes to increase oxygen supply to body tissues are noticeable in those body systems that are directly related to oxygen delivery, but the changes probably occur in all organ systems. In physiological response to acute exercise, there are several components that dictate what will be the magnitude and direction of the physiological response. The key components of "acute exercise" are the intensity at which the exercise is performed and the duration of the individual exercise bout (McArdle, Katch and Katch, 1996; Pollock and Wilmore, 1990).

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Typically the greater the intensity of exercise, the greater the degree of stress placed upon the physiological system. Relative to duration, typically extending the length of time of an exercise bout at any given intensity tends to amplify the physiological response; that is, as a person exercises longer and longer, one can see a gradual and further increase in the physiological and biochemical levels (Galbo *et al*., 1977). Exercise, a common active stress, can elicit cardiovascular abnormalities not present at rest. Dynamic exercise is preferred for testing because it puts a volume stress rather than a pressure load on the heart and because it can be graduated. When dynamic exercise is begun or increased, oxygen uptake by the lungs quickly increases. After the second minute, oxygen uptake usually remains relatively stable at each intensity of exercise. During steady state of exercise, heart rate, cardiac output, blood pressure, and pulmonary ventilation are maintained at reasonably constant levels (Rowell, 1986). The body's response to dynamic exercise consists of a complex series of cardiovascular adjustments to provide active muscles with the blood supply appropriate for their metabolic needs, to dissipate the heat generated by active muscles, and to maintain the blood supply to the brain and the heart. Exercise is an incredibly important part of a healthy person's life.

Exercising regularly helps to hone one's athletic skills by strengthening the muscles across the bodies, and also by enhancing the functioning of all internal organs. When the body engages in exercise training several times a week or more frequently, each of these physiologic systems undergoes specific adaptations that increase the body's efficiency and capacity. The magnitude of these changes depends largely on the intensity and duration of the training sessions, the force or load used in training, and the body's initial level of fitness. Exercise is considered to be a more intensive physical activity than the normal activities of daily living. There are two main types of exercises: aerobic exercise and anaerobic exercise. Aerobic exercise is a physical activity that increases the activity of the pulmonary and cardiovascular systems. It requires an increase in oxygen to be used and transported to the muscle. Conversely, anaerobic exercise is physical activity of a short duration and of less intensity than aerobic exercise. It does not require an increase in oxygen to be used and transported to the muscle. Aerobic and anaerobic training focuses on very different results on the body, it is easy to assume there are many different adaptations the body must make if one were to choose to only exclusively train aerobic or anaerobic. There is a scarcity of research work carried out to identify the impact of training modalities on stroke volume responses to exercise stress. Hence, the investigator proposed to examine whether stroke volume responses to exercise could be significantly influenced by different training protocols.

MATERIALS AND METHODS

Forty-five untrained male university students, in the age group of twenty to twenty-five years were selected as participants, and they were segregated into three groups namely: control, aerobic and anaerobic training groups. The participants were selected from Annamalai University in Tamilnadu. The aerobic and anaerobic training programs were used as experimental treatment. The duration of experimentation period was restricted to twelve weeks and the frequency of training was thrice a week. The other independent variable confined to this study is aerobic exercise stress testing using Bruce treadmill protocol to evaluate its influence on the stroke volume. The data on stroke volume were measured at rest and after exercise condition during both pretest and posttest. The standardized testing procedures and instruments used to collect the data on stroke volume were as presented in the Table 1.

Table 1. Dependent Variable and their Respective Tests

Variables	Instruments/methods	Unit of Measurement
Stroke volume	Doppler Ultrasound	ml/beat

Experimental Design and Statistical Techniques: The experimental design used in this study was random group design involving forty-five untrained male university students, who were segregated into three groups of fifteen each. The data thus collected from experimental and control groups at rest and after exercise condition during pre and post test have been analyzed by three-way factorial ANOVA with repeated measures on last two factors. In all the cases level of confidence was fixed at 0.05 for significance.

Results of the Study: The data on stroke volume have been analyzed by three-way factorial ANOVA (3x2x2) with repeated measures on last two factors and the obtained results are presented in Table 2. Table 2 indicates that significant differences exist among groups irrespective of training and exercise conditions on stroke volume, and also between pretest and posttest data on stroke volume irrespective of groups and exercise conditions. Thereby, significant difference exists for the interaction of groups at pre and post tests on stroke volume irrespective of exercise conditions.

Table 2 also reveals that significant differences exist between resting and exercise conditions irrespective of groups at pre and post tests on stroke volume, and also for the interaction of groups at rest and after exercise conditions irrespective of pre and post tests on stroke volume. Furthermore, Table 2 shows that significant difference exists on stroke volume among resting and after exercise conditions at pre and post tests irrespective of groups. The results of the study indicate that significant differences exist in the three way interaction of groups, training and exercise conditions on stroke volume.

Table 3 indicates that stroke volume did not vary significantly between groups during pre test period at rest and after exercise conditions, however, significant difference exists on stroke volume between groups at rest and after exercise conditions during posttest period (for which the post hoc test was performed and presented in Table 4 and 5).

The result of the study also indicates that stroke volume at rest and in response to exercise of aerobic and anaerobic training groups altered significantly for better as a result of training. However no significant changes on stroke volume were found among tests at resting and in response to exercise condition of control group. Furthermore, the findings indicates that stroke volume of all the three groups elevated significantly in response to exercise during pretest and posttest period.

Table 2. Three Way Factorial ANOVA on Stroke Volume

Source of Variance	Sum of Squares	df	Mean Squares	F ratio
Groups	4051.744	2	2025.872	185.509*
Error (Group)	458.667	42	10.921	
Training	8120.450	1	8120.450	757.909*
Groups and Training	4003.300	2	2001.650	186.8218*
Error (Training)	450.000	42	10.714	
Exercise	143312.450	1	143312.450	23993.315*
Group and Exercise	138.433	2	69.217	11.588*
Error (Exercise)	250.867	42	5.973	
Training and Exercise	107.339	1	107.339	41.259*
Training, Exercise and Group	49.144	2	24.572	9.445*
Error	109.267	42	2.602	

*Significant at .05 level of confidence

(Table values required for significance at .05 level with df 1 & 42 and 2 & 42 are 4.07 and 3.23 respectively.)

Table 3. The Simple Effect Scores on Stroke Volume

Source of Variance	Sum of Squares	df	Mean Squares	F ratio
Groups at rest during pre test	3.355344	2	1.677672	0.644763
Groups after exercise during pre test	3.466333	2	1.733167	0.66609
Groups at rest during post test	1464.874	2	732.4372	281.4901*
Groups after exercise during post test	2649.617	2	1324.809	509.1502*
Tests at rest and group I	2881.2	1	2881.2	1107.302*
Tests at rest and group II	1888.141	1	1888.141	725.65*
Tests at rest and group III	0.3	1	0.3	0.115296
Tests after exercise and group I	4368.121	1	4368.121	1678.755*
Tests after exercise and group II	3141.644	1	3141.644	1207.396*
Tests after exercise and group III	0.833167	1	0.833167	0.320202
Tests during pre test and group I	23352.3	1	23352.3	8974.75*
Tests during pre test and group II	22632.51	1	22632.51	8698.119*
Tests during pre test and group III	21816.09	1	21816.09	8384.353*
Tests during post test and group I	27300.8	1	27300.8	10492.24*
Tests during post test and group II	26581.6	1	26581.6	10215.84*
Tests during post test and group III	21924.06	1	21924.06	8425.849*
Error	109.267	42	2.602	

*Significant at .05 level of confidence

(Table values required for significance at .05 level with df 1 and 42 and 2 and 42 are 4.07 and 3.23 respectively.)

Table 4. The Scheffè S Test for the Differences between Paired Means on Stroke Volume of Groups at Rest during Post Test

Aerobic Training Group	Anaerobic Training Group	Control Group	Mean Difference	Confidence Interval
84.200	81.067		3.133*	1.497
84.200		65.733	18.467*	1.497
	81.067	65.733	15.334*	1.497

*Significant at .05 level of confidence

Table 4 shows that significant differences exists between aerobic and anaerobic training groups, aerobic training and control groups and anaerobic training and control groups on stroke volume at resting condition during post test period. It is inferred from the result of the study that the stroke volume at resting condition of aerobic training group is significantly better than anaerobic training group during post test period.

Table 5. The Scheffè S Test for the Differences between Paired Means on Stroke Volume of Groups after Exercise during Post Test

Aerobic Training Group	Anaerobic Training Group	Control Group	Mean Difference	Confidence Interval
144.533	140.600		3.933*	1.497
144.533		119.800	24.733*	1.497
	140.600	119.800	20.800*	1.497

*Significant at .05 level of confidence

Table 5 shows that significant differences exists between aerobic and anaerobic training groups, aerobic training and control groups and anaerobic training and control groups on stroke volume after exercise condition during post test period. It is inferred from the result of the study that the stroke volume in response to exercise of aerobic training group is significantly better than anaerobic training group during post test period.

RESULTS AND DISCUSSION

The results of the present study are in conformity with the findings of the previous research studies. It is fact that numerous physiological variables change as a result of exercise to maintain homeostasis and muscular work. Piira and others (2010) assessed the heart rate (HR) dynamics and found that cardiac vagal outflow is attenuated and vasomotor sympathetic activity elevated during exciting sports events. The stroke volume in highly trained persons can continue to increase up to near maximal rates of work (Scruggs *et al*., 1991; Gledhill, Cox and Jamnik, 1994). Several factors contribute to the increase in stroke volume from sports training. The athlete's heart structure augments stroke volume. Left ventricular end-diastolic internal diameter and left ventricular end-diastolic wall thickness increase in parallel so that their ratio is not significantly altered (White *et al*., 1987). Stroke volume increases in parallel with the increased end-diastolic volume so that muscle fiber shortening is maintained.

Conclusions

Based on the findings of the study it was concluded that the stroke volume at rest and after exercise conditions of aerobic and anaerobic training groups altered significantly for better as a result of respective training, where aerobic training has the upper hand as compared to anaerobic training for its effectiveness on stroke volume.

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