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ARTERIAL BLOOD PRESSURE AND HEART RATE RESPONSE TO EXERCISE

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Abstract

The current investigation is likely to illuminate the variableness on arterial blood pressure and heart rate in response to exercise. For this purpose, fifteen male kabaddi players in the age group of 20 to 25 years were selected as subjects from Annamalai University, during their competitive season. The selected dependent variables such as (systolic blood pressure, diastolic blood pressure, mean arterial pressure and heart rate) were appraised using Oscillometric method and instruments of scientific standards at resting conditions and after exercise. To statistically analyse and compare the changes on arterial blood pressure and heart rate response to exercise, 't' test was used. The analysis of data revealed that there is a significant magnification on systolic, diastolic, mean arterial pressure and heart rate in response to exercise. These findings suggest that exercise induces significant transformation in cardiovascular variables.

Keywords: Exercise, Blood Pressure, Heart Rate

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, when the stress is removed. Thus, upon exposure to a passive stress, the body undergoes a hierarchy of responsive changes, the physiological 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.

The change in physiological characteristics is the interaction of individual's uniqueness and the magnitude of exercise stress as defined by the extent (distance/time) and the velocity of movement or revolutions. Physical conditioning can be measured as changes in VO_{2max}, exercise test time, submaximal heart rate response, or ability to perform a standard amount of exercise.

Exercise, a common physiological 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.

As cardiac output increases with dynamic exercise, peripheral resistance increases in organ systems and tissues that do not function during exercise and decreases in active muscles (Higginbotham, 1988). Arterial blood pressure increases only mildly; thus, flow can increase as much as fivefold. The increase in flow is much more than the pressure that results in a decrease in systemic vascular resistance.

An increase in heart rate due to a decrease in vagal outflow is an immediate response of the cardiovascular system to exercise; this increase is followed by an increase in sympathetic outflow to the heart and systemic blood vessels. During dynamic exercise, heart rate increases linearly with workload and $\dot{V}O_2$. During low levels of exercise and at a constant work rate, heart rate will reach steady state within several minutes. As workload increases, the time necessary for the heart rate to stabilize will progressively lengthen.

Heart rate response is influenced by several factors, including age. There is a decline in mean maximum heart rate with age (Londeree & Moeschberger, 1984), which appears to be related to neural influences. Dynamic exercise increases heart rate more than isometric or resistive exercise. An

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accentuated heart rate response is observed after bed rest. Other factors that influence heart rate include body position, certain physical conditions, state of health, blood volume, and environment.

Heart rate is acutely elevated immediately following a work bout (Fleck, 1988). Interestingly, in terms of chronic adaptations, there appears to be a reduction in heart rate from training, which is considered beneficial (Stone *et al*., 1991).

Blood pressure is dependent on cardiac output and peripheral resistance. Systolic blood pressure at maximum exertion or at immediate cessation of exertion is considered a clinically useful first approximation of the heart's inotropic capacity. The systolic arterial pressure is the peak pressure in the arteries, which occurs near the beginning of the cardiac cycle; the diastolic arterial pressure is the lowest pressure. The average pressure throughout the cardiac cycle is reported as mean arterial pressure (Poullis, 1999), which has physiologic and clinical importance, since it represents the perfusion pressure and it is a factor utilised in the calculation of haemodynamic variables. These measures of arterial pressure are not static, but undergo natural variations from one heartbeat to another and throughout the day; they also change in response to stress, nutritional factors, drugs, or disease.

Systolic blood pressure rises with increasing dynamic work as a result of increasing cardiac output, whereas diastolic pressure usually remains about the same or may be heard to zero in some normal subjects. The slight decrease in diastolic blood pressure is due primarily to the vasodilation of the arteries from the exercise bout.

During exercise bout, systolic and diastolic blood pressures may show dramatic increases (Stone *et al*., 1991). The extent of the increase in blood pressure is dependent on the time and intensity of the exercise bout, and the amount of muscle mass involved (Fleck, 1988). More dynamic forms of training are associated with reductions in blood pressure.

The purpose of the present study was to clarify the changes on arterial blood pressure and heart rate in response to exercise among male kabaddi players.

Methods and Procedures

Fifteen male Kabaddi players, those represented Annamalai University in the All India Inter University Kabaddi Tournament volunteered as subjects. The selected subjects were in the age group of 20 to 25 years, and they were recruited for the purpose of the study with their informed consent.

The independent variable considered in this study was
physical exercise (*Cooper's 12 minutes run/walk*). The selected dependent variables were assessed using calibrated and standardized instruments and procedures before and after exercise. The dependent variables and method used are presented in table-1.

Table-1: Dependent Variables

SL. No.	Variables	Method / Formula	Units of Measurement
1.	Systolic blood pressure	Oscillometric method	mmHg
2.	Diastolic blood pressure	Oscillometric method	mmHg
3.	Mean Arterial Pressure	MAP = P_{DIAS} + 1/3 (P_{SYS} – P_{DIAS})	mmHg
4.	Heart rate	Oscillometric method	Number

The initial test was carried out in the early morning at resting conditions on the day of exercise testing. Then, Cooper's 12 minutes run/walk was used to assess the influence of it, on the changes in heart rate and arterial blood pressure of the participants. The standard procedures were followed to administer the test as mentioned by Clarke (1976). The digital wrist blood pressure monitor was used to detect the basal and exercise arterial blood pressure and heart rate, in the upright sitting position.

Experimental design and statistical techniques

Random group design involving fifteen subjects was used for the purpose of revealing the influence of exercise on arterial blood pressure and heart rate. To determine the significant variation, if any, the data collected before and after exercise on selected dependent variables were subjected to statistical analysis using 't' test. The level of significance was accepted at $P < 0.05$.

Results and Discussion

The age and weight of the selected subjects averaged 22.4 ± 1.6 yr and 68.2 ± 4.37 kg respectively. The analysis of data collected on arterial blood pressure and heart rate at rest and after exercise is presented in table 2.

The findings of the study shows that there is a significant difference on systolic blood pressure,

diastolic blood pressure, mean arterial blood pressure and heart rate among the basal and after exercise values, since the obtained 't' ratio of 4.673, 5.841, 6.410 and 13.961 is greater than the required table value of 2.048 for significance at 0.05 level of confidence.

Table - 2: Computation of Data on Arterial Blood Pressure and Heart Rate at Rest and After Exercise

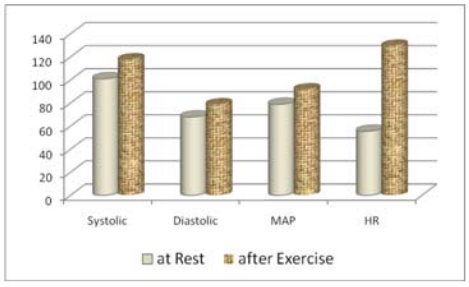
Variable	Group	N	$\bar{X}$	σ	DM	σDM	't' ratio
Systolic Pressure	At Rest	15	101. 00	5. 35	16.93	3.623	4.673*
	After Exercise	15	117. 93	12. 97			
Diastolic Pressure	At Rest	15	67. 87	5. 17	11.06	1.894	5.841*
	After Exercise	15	78. 93	5. 20			
Mean Arterial Pressure	At Rest	15	78. 91	4. 71	13.02	2.031	6.410*
	After Exercise	15	91. 93	6. 30			
Heart Rate	At Rest	15	55. 47	3. 94	74.33	5.324	13.961*
	After Exercise	15	129. 80	20. 24			

* Significant at 0.05 level

Required table value for significance at 0.05 level of confidence for df of 28 is 2.048

The graphical representation of the mean scores on arterial blood pressure and heart rate at rest and after exercise is given in figure-I.

Fig.I: Graphical Representation of Data on Arterial Blood Pressure and Heart Rate



Conclusions

The present investigation exhibits that exercise stress induces significant changes on systolic blood pressure, diastolic blood pressure, mean arterial pressure and heart rate. The findings of the study is in line with the view of Brooks, Fahey and White (1996) that systolic blood pressure rises steadily during exercise, in a similar trend to that of heart rate. With individual variation systolic blood pressure increases to 180 mm Hg or more during maximal exercise, while, diastolic pressure changes little during exercise in normal people. Typically, there is either no change or a slight decrease of less than 10 mm Hg during exercise.

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