Effects of Exercise on Blood Pressure, Pulse and Respiratory Rates in Young Normotensive Subjects

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ABSTRACT

Worldwide aerobic exercise is being promoted for its beneficial effect on health, especially the cardiovascular system. Physical exercise enhances or maintains physical fitness and overall wellness. This study was undertaken to investigate the effects of exercise on blood pressure, pulse and respiratory rates in young normotensive subjects. Ninety-nine male subjects participated in the study. They were randomly assigned into three groups of thirty-three subjects each. Group A completed 30 minutes of exercise by jogging. Group B did 30 minutes of exercise by riding bicycle ergometer, while Group C completed 30 minutes of exercise by walking. Using a digital automatic blood pressure monitor, blood pressure and pulse rate were taken at rest and immediately after exercise. Respiratory rate was counted at rest and immediately after exercise. The data were recorded and analyzed. Results showed that exercise significantly elevated the systolic blood pressure, pulse and respiratory rates in groups A, B and C. There was little or no effect on diastolic blood pressure. The increase in systolic blood pressure, pulse and respiratory rates was more in group A (jogging) than in group B (bicycle ergometer) and lastly group C (walking). The information provided by this study should be regarded as a valuable baseline data that could be helpful in creating safe exercise plans and healthy lifestyles in our environment.

Keywords: Exercise, Pulse Rate and Blood Pressure.

INTRODUCTION

Exercise is the performance of any physical activity for the purpose of conditioning the body, improving health, or maintaining fitness or as a means of therapy for correcting a deformity or restoring the organs and bodily functions to a state of health. Furthermore, it is any action, skill or maneuver that exerts the muscles and is performed repeatedly in order to develop or strengthen the body or any of its parts (Glanze *et al.,* 1990).

Physical exercises are generally grouped into three types, depending on the overall effect they have on the human body.

- Aerobic exercise e.g. cycling, swimming, walking, skipping rope, rowing, running, hiking or playing tennis, focus on increasing cardiovascular endurance (Wilmore and Knuttgen, 2003).

- Anaerobic exercises e.g. weight training, functional training, eccentric training or sprinting and high intensity interval training, increase short-term muscle strength (De Vose *et al.,* 2005).

- Flexibility exercises, such as stretching, improve the range of motion of muscles and joints (O'Connor *et al.,* 2005).

Regular exercise has been shown to promote physical capacity and reduce the risk of heart diseases (Morris, 1994; Bouchard *et al.,* 1994). Aerobic exercise is currently being promoted as a lifestyle modification that lowers resting blood pressure, especially in persons with elevated levels (American College of Sports Medicine, 1993: Fagard, 1999; Fagard and Tipton, 1994; Halbert *et al.,* 1997). This may be via both a direct independent effect (Paffenbarger *et al.,* 1986; Shaper and Wannamethee, 1991; Farell *et al.,* 1998) and via its influence upon other established risk factors (Blair *et al.,* 1995).

Physical activity is thought to have other beneficial effects related to cognition as it increases levels of nerve growth factors, which support the survival and growth of a number of neuronal cells (McAuley *et al.,* 2004). A 2008 review of cognition enrichment therapies concluded that physical activity and aerobic exercise in particular enhances older adults' cognitive function (Hertzog *et al.,* 2008). In addition, physical activity has been shown to be neuroprotective in many neurodegenerative and neuromuscular diseases (Grondard *et al.,* 2005).

The four main vital signs routinely monitored by medical professionals and healthcare providers include blood pressure, temperature, pulse and respiratory rates. Blood pressure is the pressure exerted by circulating blood upon the walls of blood vessels. A person's blood pressure is usually expressed in terms of the systolic pressure over diastolic pressure and is measured in millimeters of mercury (mmHg). Normal values fluctuate through 24-hour cycle with highest readings in the afternoons and lowest readings at night (VonBerg-Landry *et al.,* 2008) Respiratory rate is the number of breaths taken in one minute. The pulse rate is the number of pulsations felt over a peripheral artery (radial artery) or heard over the apex of the heart in one minute. This rate normally corresponds to the same rate at which the heart is beating (Taylor *et al.,* 2008).

This study was undertaken to investigate the effects of exercise on blood pressure, pulse and respiratory rates in young normotensive subjects. There is a need for an establishment of baseline data of the relationship between exercise and blood pressure, pulse and respiratory rates that will address the peculiarity of the Nigerian environment.

MATERIALS AND METHODS

Subjects and Study Area

This study was carried out in Anambra State University, Uli Campus. The subjects comprised ninety-nine apparently healthy young students of the university with normal blood pressure. The subjects were males and were randomly selected from different departments in Uli campus. All subjects freely consented to participate in the study after we briefed them on the essence of the study. Ethical approval was obtained from the Ethics Committee of the Faculty of Basic Medical Sciences.

Experimental Design

The subjects were randomly assigned to three groups of thirty-three subjects each. The exercise programme of group A was jogging, B was riding of bicycle ergometer, and C was walking. Smokers, alcoholics, hypertensive subjects or those with family history of hypertension were excluded from the study. Inclusion criteria were young (between the ages 18-30) and apparently healthy. The experiments were conducted in the mornings and evenings in order not to interfere with the subjects' daily activities. Compliance was therefore enhanced. Blood pressure, pulse and respiratory rates of the subjects were taken at rest. Group A subjects jogged for 30 minutes. Group B rode bicycle ergometer for 30 minutes. Group C walked for 30 minutes. Immediately after these exercises, blood pressure, pulse and respiratory rates were again taken.

Measurements

In measuring the blood pressure, each subject was made to rest for at least five minutes, in a sitting position before the blood pressure reading was taken. Using an automatic blood pressure monitor (Omron Model HEM-705CP, Made in China by Omron Healthcare, Inc.) measurement of pulse rate and blood pressure was done before the exercise (at rest) and immediately after the exercise. Respiratory rate was counted (and expressed as per minute). Blood pressure was expressed as systolic/diastolic mmHg, while pulse was expressed as beats/minute. Data were recorded and analyzed.

Statistical Analysis

The data obtained were expressed as mean ±SEM. The student's t-test was applied and p-values were determined. Differences were considered significant at $P<0.05$.

RESULTS

In group A (jogging), exercise significantly increased the systolic blood pressure by 9.89%, pulse rate by 46.78% and respiratory rate by 34.15%. There was little or no effect on diastolic blood pressure.

In group B (bicycle ergometer) exercise significantly increased systolic blood pressure by 9.09%, pulse rate by 32.23% and respiratory rate by 14.91%. Diastolic pressure remained unchanged. In group C (walking), exercise significantly increased systolic blood pressure by 5.24%, pulse rate by 8.94% and respiratory rate by 18.43%.There was no effect on diastolic pressure.

Table 1: Effect of Jogging on Blood Pressure, Pulse and Respiratory Rates

	At rest	Mean ±SEM(after exercise)	% change	P-value
Systolic	119.9±0.96	131.76±0.66*	9.89	0.011
Diastolic	79.97±0.03	80.06±0.06	0.11	0.863
Pulse rate	78.33±1.47	114.97±2.77*	46.78	0.000
Resp. rate	15.52±0.40	20.82±0.32*	34.15	0.005

* = Significant (P<0.05)

Table 2: Effect of Bicycle Ergometer on Blood Pressure, Pulse and Respiratory Rates

	At rest	Mean ±SEM(after exercise)	% change	P-value
Systolic	121.67±1.22	132.73±0.93*	9.09	0.000
Diastolic	80.00±0.00	80.00±0.00	0.00	-
Pulse rate	68.73±0.57	90.88±1.63*	32.23	0.000
Resp. rate	18.91±0.36	21.73±0.35*	14.91	0.000

* = Significant (P<0.05)

Table 3: Effect of Walking on Blood Pressure, Pulse and Respiratory Rates

	At rest	Mean ±SEM(after exercise)	% change	P-value
Systolic	120.85 ±1.14	127.18±1.07*	5.24	0.000
Diastolic	80.00 ±0.00	80.06±0.06	0.075	-
Pulse rate	65.79 ±0.65	71.67±0.91*	8.94	0.000
Resp. rate	17.91 ±0.29	21.21±0.25*	18.43	0.005

* = Significant (P<0.05).

DISCUSSION

The results of this study showed that jogging elevated the systolic blood pressure, pulse and respiratory rates more than bicycle ergometer, and lastly walking. This is in the order of jogging >bicycle ergometer > walking. However, walking increased the respiratory rate by 18.43% compared with 14.91% in bicycle ergometer.

The physiological response to exercise is dependent on the intensity, duration and frequency of the exercise as well as the environmental conditions. During physical exercise, requirements for oxygen and substrate in skeletal muscle are increased as are the removal of metabolites and carbon dioxide. The chronotropic effect of exercise on the heart may be due to stimulation from the noradrenergic sympathetic nervous system. The increase in heart rate is also mediated by vagal inhibition and is sustained by autonomic sympathetic responses and carbon dioxide acting on the medulla (Burton *et al.,* 2004).

Systolic blood pressure represents the maximum exerted pressure on the vessels when the heart contracts, while the diastolic pressure, the second reading represents the minimum pressure in the vessels when the heart relaxes (Klabunde, 2011). In this present study, exercise significantly increased the systolic blood pressure in jogging, walking and bicycle ergometer with little or no effect on the diastolic pressure. During muscular contraction, blood flow is restricted briefly but overall, it is enhanced by the pumping action of the muscle. The increase in blood flow to muscles requires an increase in the cardiac output, which is in direct proportion to the increase in oxygen consumption. The cardiac output is increased by both a rise in the heart rate and stroke volume attributable to a more complete emptying of the heart by a forcible systolic contraction (Burton *et al.,* 2004).

The result of the present study showed that exercise significantly increased respiratory rate in jogging, walking and bicycle ergometer. This is due to the fact that during exercise, ventilation might increase from resting values. The increase in pulmonary ventilation is attributable to a combination of increase in tidal volume and respiratory rate and closely matches the increase in oxygen uptake and carbon dioxide output.

Often, exercise is recommended to help burn off fat. Regular aerobic activity has been shown to decrease total cholesterol (TC), triglycerol (TAG), very low-density lipoprotein (VLDL) (Tamai *et al.,* 1992; Seip *et al.,* 1993). It increases high density lipoprotein cholesterol (HDL-C) (Ebisu, 1985; Thompson *et al.,* 1988; Suter *et al.,* 1990). The implications of these changes have been linked to the prevention or slowing down of the atherosclerotic process (Kramsch *et al.,* 1981) and consequently have clear benefits to an individual's cardiovascular health.

CONCLUSION

We investigated the effects of exercise on blood pressure, pulse and respiratory rates in young normotensive subjects who are students of a tertiary institution. Jogging, bicycle ergometer and walking significantly increased systolic blood pressure, pulse and respiratory rates. More vigorous exercise caused higher increase. However, despite the fact that exercise caused an increased in systolic blood pressure in all groups, the mean systolic pressure after exercise was within normal range. The information provided by this study should be regarded as a valuable baseline data. Further studies are recommended. Comparisons after completing the same activity for a prolonged period of time versus a short period of time could be made. It would also be interesting to see if the results of these experiments would stay the same when comparing age groups, genders, or fitness levels.

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