

EFFECT OF LIGHT AND EXHAUSTIVE ERGOMETRIC EXERCISE ON BLOOD SUGAR, TOTAL CHOLESTEROL AND pH IN UNTRAINED YOUNG HUMAN SUBJECTS

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Summary : Light and exhaustive ergometric exercise in untrained male and female medical students in the age group 18-21 years resulted in significant lowering of the blood sugar, cholesterol and pH. Females exhibited hypoglycemia of slightly greater magnitude as compared to male subjects during both the exercises, however, such sex differences were not observed for changes in cholesterol and pH.

Key words : ergometric exercise
blood pH

total serum cholesterol
exhaustive exercise

light exercise
blood sugar

INTRODUCTION

Controversial reports are available regarding the changes in blood sugar in various types of exercises. Young *et al.* (19) have reported decline in blood sugar during prolonged Tread-mill exercise. Pruett (13) reported slight drop in blood sugar during first ten min of exercise but the sugar level increased above pre-exercise level upon exhaustion. Football players have been shown to exhibit marked hyperglycemia during first half hr of the play and normal sugar levels at the end of the play (4). Goldstein (6) has reported development of hypoglycemia during and after muscular exercise in the normal and diabetic dogs. Rise in arterial glucose level during leg exercise has been shown by Wahren *et al.* (17). Heavy exercise for an hr immediately after ingestion of glucose has been reported to decrease the hyperglycemic level rapidly, however, violent exercise just before ingestion of glucose was found to exaggerate hyperglycemia in man (18).

According to Carlson and Mossfeldt (3), no significant changes occur in the blood cholesterol level even after 8-9 hrs skiing exercise. Goode *et al.* (7) have reported progressive decrease in serum cholesterol during exercise. Campbell (2) has shown that different types of exercises affect the cholesterol level to different degrees. Malinow *et al.* (8, 10) have also observed lowering in serum cholesterol during exercise.

Osnes and Harmansen (12), and Turrell and Robinson (16) have reported significant lowering in blood pH during and after exercise.

Keeping in view such variable reports, we have studied the effect of ergometric exercise on blood sugar, total serum cholesterol and blood pH in groups of male and female medical students.

MATERIALS AND METHODS

Untrained, non-athlete male and female medical students in the age group of 18-21 years

were selected. All the students received common hostel diet. They were divided in two groups. One group was subjected to light exercise (1500 revolutions) and another group to exhaustive exercise on Monarch Bicycle ergometer. Exhaustive exercise was taken as that one in which the subjects felt complete inability to ply the wheel of ergometer any more in continuity. The subjects did not take any thing except sugarless tea and water in the morning before doing exercise.

Blood samples were drawn from the antecubital vein before and immediately after finishing the exercise. The subjects were given water on demand during the course of exercise. Blood sugar was determined according to Nelson, and Somogyi (11, 15) and total serum cholesterol according to Abell *et al.* (1). Changes in pH were recorded in the ELICO pH meter having a sensitivity of .05 pH unit.

RESULTS

The results of analysis for sugar, cholesterol and pH before and after light and exhaustive exercise have been summarised in Table I. Changes brought about by light and exhaustive exer-

Table I: Effect of light and exhaustive exercise on cycle ergometer on blood sugar, pH and serum cholesterol in male and female medical students in the age group 18-21 years.

Investigation	Sample size	BE	AE	Overall change
Blood Sugar (mg/100 ml)				
Light exercise				
Male	17	101.2±8.7	86.5±11.8	14.7±6.5 (14.5%)
Female	14	105.4±12.2	83.2±11.6	22.2±8.6 (21%)
Exhaustive exercise				
Male	17	105.5±19.0	88.7±17.2	16.8±8.8 (15.9%)
Female	14	109.0±11.3	83.2±13.8	25.8±12.5 (23.6%)
Serum cholesterol (mg/100 ml)				
Light exercise				
Male	17	164.5±15.6	150.3±15.3	14.2±7.6 (8.6%)
Female	14	166.8±23.0	148.5±19.5	18.3±13.0 (10.9%)
Exhaustive exercise				
Male	20	161.9±10.6	143.6±11.9	18.3±8.4 (11.3%)
Female	14	174.5±28.8	156.6±19.4	17.9±7.1 (10.2%)
Blood pH				
Light exercise				
Male	14	7.36±.05	7.26±.05	0.10±.05
Female	07	7.43±.08	7.30±.06	0.13±.10
Exhaustive exercise				
Male	18	7.38±.10	7.28±.13	0.10±.10*
Female	10	7.41±.05	7.31±.10	0.10±.05

Note : Figures in parenthesis represent per cent change.

Be : Before exercise, AE : After exercise

P<0.001 *Insignificant.

cises were found to be almost of the same magnitude. In the male students, blood sugar level was found to have lowered by 14.5 and 15.9 per cent immediately after finishing light and exhaustive exercises, respectively. In the female students, however, blood sugar levels after similar exercises were found to be lowered by (21.0 and 23.6%). In both the cases, lowering in blood sugar levels was found to be highly significant ($P < .001$).

Serum cholesterol was found to be lowered by 8.6 and 11.3 per cent in male and 10.9 and 10.2 per cent in female students during light and exhaustive exercises, respectively.

Blood pH showed a shift towards acidic side by about 0.1 to 0.13 pH units in both the groups during light and exhaustive exercises.

DISCUSSION

Heavy exercise is known to accelerate the rates of peripheral utilization of sugar, and depletion of glycogen from their stores in liver and muscles (17, 18). Rise in blood sugar during early period of exercise accompanied by a fall towards the end of exercise has been reported by several workers (6, 13, 19). Exercise accompanied with emotional stress, as in competitions during which epinephrine secretion is increased, has been reported to result in hyperglycemia during and after exercise (4). Present experiments show hypoglycemia at the end of light as well as exhaustive exercise, the magnitude of hypoglycemia being less in the male subjects than the females. The data are suggestive of increased peripheral utilization of sugar surpassing the rate of glycogenolysis thus resulting into hypoglycemia. We are at present not able to give definite reasoning for females showing greater degree of hypoglycemia in comparison to males after both the types of exercises.

Present studies reveal that the total serum cholesterol is significantly lowered at the end of exercises of both types. Controversial reports regarding effect of exercise on cholesterol level are available in the literature. Carlson and Mossfeldt (3) are of the opinion that even 8 to 9 hrs skiing exercise does not bring about any change in the serum cholesterol levels. Goode *et al.* (7) have reported progressive decrease in serum cholesterol with exercise. Our findings are also consistent with those of Campbell (2), Malinow *et al.*, (8), and Malinow *et al.* (10). Fox and Spinner (5) have also reported lowering of serum cholesterol and reduction in the incidence of atherosclerosis as a result of doing exercise. The generally accepted view regarding lowered cholesterol levels due to exercise is increased oxidation of cholesterol and its increased uptake by the tissues (9). Malinow *et al.* (9) have further shown that liver and adrenals are mainly responsible for catabolizing cholesterol during exercise.

As expected, our data also show shift of the blood pH towards acidic side as compared to their respective pre-exercise values. Such shifts have also been reported after exercise by other authors (12, 16). However, the magnitude of the shift of pH observed by these authors was greater than what we have observed. The primary cause for this shift of pH appears to be excess formation of lactic acid and its subsequent squeezing into the blood stream (12, 16).

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