ALTERATION IN ROUTINE BIOCHEMICAL PARAMETERS AFTER MODERATE PHYSICAL EXERCISE IN HEALTHY PREMENOPAUSAL FEMALE VOLUNTEERS

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ABSTRACT

Background: Physical exercise contributes to maintaining good health as it can prevent various chronic diseases like hypertension, diabetes mellitus, cancer, obesity, cardiovascular diseases, bone and joint diseases, including osteoporosis. Objective: To estimate the routine biochemical parameters after moderate physical exercise in healthy premenopausal female volunteers and to compare these parameters before exercise and after exercise. Methods: Thirty premenopausal female volunteers without any menstrual irregularities in the age group 20-50 years were included. They performed walking for 30 minutes, and blood samples were collected 15 minutes before exercise, 1 hour after exercise and 24 hours after exercise. Routine biochemical parameters were done and compared before and after exercise. Female volunteers with menstrual disorders, medication history, chronic diseases such as hyper/hypothyroidism, diabetes mellitus, hypertension, respiratory diseases were excluded from the study. Result: Significant decrease was found in levels of blood glucose, serum sodium and potassium, although they remained within normal range. The alterations in other routine parameters like serum urea, uric acid, LDL and total cholesterol were insignificant. Conclusion: The present study showed that moderate physical activity has a significant effect on selected biochemical parameters like blood glucose and serum electrolytes.

KEYWORDS Moderate exercise, Biochemical parameters, Healthy female volunteers, Premenopausal

Introduction

Physical exercise contributes to enhancing good health and lowering the risk of several diseases such as cardiovascular diseases. Alteration in laboratory test levels in relation to the frequency of exercise, type, age & sex may provide a better measure of estimation of improved fitness and reduction in the risk of various chronic diseases.[1]

Physical exercise induces a gain of bone mass, especially in weight-bearing bone sites and improves both bone formation as well as bone mineral density. The role of exercise is particularly important in children and adolescents as their bone mineral density reaches 90% of its peak by the end of the second decade.[2-4] American College of Sports Medicine (ACMS) classified physical activity intensity on the basis of maximal heart rate. For moderate-intensity physical activity, a target heart rate of a person should be 55% to 69% of his or her maximum heart rate.[5]

Calcium has a crucial role in various physiological processes such as skeletal mineralization, blood coagulation, the excitability of skeletal, cardiac muscles, neuromuscular conduction,
Written informed consent was obtained from participants, and withdrawal before exercise in plain red vacutainer aseptically. The second and third blood samples were collected after one hour and 24 hours of the exercise, respectively. In addition, from the antecubital vein. After 15 minutes of rest, they performed moderate physical exercise in walking for 30 minutes.

Blood glucose levels are significantly decreased after exercise, indicating better glucose regulation due to changes in beta cell functioning. Physical activity increases glucose uptake by active muscles and is balanced by hepatic glucose output. As the exercise intensity increases, this dependence of muscles on carbohydrates to fuel muscular activity also increases. A: G increases due to higher levels of albumin and decreased levels of globulin that are associated with physical exercise. There is an increased rate of red blood cell turnover stimulated by exercise conditions such as muscle contraction and high oxygen with resultant elevation in bilirubin levels.

Regular and moderate exercise has provided various beneficial health effects, including reduced risk of cardiovascular diseases, certain cancers, osteoporosis, and obesity. Nevertheless, certain forms of exercise and particularly maximal exercise, are also accompanied by some deleterious effects. Muscle damage after exercise can result in a substantial increase in myocardial protein levels in the blood. Studies have shown that prolonged physical exercise results in transient elevations of biochemical markers of muscular damage such as aspartate aminotransferase (AST), alanine aminotransferase (ALT), creatine kinase (CK), and lactate dehydrogenase (LDH).

Studies have shown that effect of exercise on biochemical parameters depends on exercise intensity, sex and age group. To the best of our knowledge, no such studies are available in the Indian context, especially in Haryana. The present study was conducted to study the alteration in routine biochemical parameters after moderate physical exercise in healthy volunteers and to compare these parameters before exercise and after exercise.

**Material and Methods**

The present study was conducted in the Department of Biochemistry in collaboration with the Department of Community Medicine, Pt. B.D. Sharma PGIMS, Rohtak. Thirty female volunteers without any menstrual irregularities in the age group 20-50 years were enrolled, mainly hospital staff. Female volunteers with menstrual disorders, medication history, chronic diseases such as hyper/hypothyroidism, diabetes mellitus, hypertension, respiratory diseases were excluded from the study.

**Methodology**

Written informed consent was obtained from participants, and detailed history was taken. Complete general, systemic and physical examination was done along with anthropometric measurements and were recorded as per protocol. The study was approved by the ethical board of the institution. After proper informed written consent, six ml of venous blood sample was withdrawn before exercise in plain red vacutainer aseptically from the antecubital vein. After 15 minutes of rest, they performed moderate physical exercise in walking for 30 minutes. The second and third blood samples were collected after one hour and 24 hours of the exercise, respectively. In addition, two ml of blood sample was collected in purple capped vacutainer (EDTA) for haemoglobin. Samples were processed within one hour of collection, and serum was separated by centrifugation (2000rpm X 10 minutes) after clotting and analysed on the same day. Various routine biochemical investigations were performed on an auto-analyzer (RandoxSuzuka) using the standard enzymatic methods. Electrolytes were measured using the Ion-selective electrodes method.

**Result**

The mean age of healthy female volunteers was 31.57±6.89 years. Out of 30 volunteers, the majority of volunteers, i.e. 13 (43.3%) females, were lab technicians, followed by 9 (30%) females who were bearers in hospital, 7 (23.3%) were staff nurses and one (3.3%) female was a sweeper in hospital. Height and weight in these women were 1.58±0.48 meters and 55.17±6.82 kg, respectively. BMI was 22.09±2.38 kg/m2. The mean value of systolic blood pressure (SBP) and diastolic blood pressure (DBP) in female volunteers fifteen minutes before exercise was 122.67±5.17 mmHg and 78.40±2.76 mmHg, respectively. Pulse rate was recorded fifteen minutes before exercise and was 84.83±8.60 beats/min. Various routine biochemical investigations were carried out before exercise and 1 hour & 24 hours after exercise and were compared using Analysis of Variance (ANOVA); (Table 1). A significant decrease was found in levels of blood glucose, serum sodium and potassium, although they remained within normal range. The alterations in other routine parameters like serum urea, creatinine, uric acid, LDL and total cholesterol were insignificant.

**Discussion**

Physical exercise induces bone mass gain, especially in weight-bearing bone sites. Physical exercise improves bone formation and bone mineral density. Physical exercise exerts external as well as internal forces on the skeleton system. This causes a variable amount of deformation in bone tissue and produces mechanical strain sensed by osteocytes, mechanosensitive cells of the bone. Osteocytes then start an adaptive response with the help of the action of osteoclasts which cause resorption of bone tissue; and via osteoblasts that produce new bone tissue. Physical exercise has been proved to be advantageous for maintaining healthy, strong bones, particularly in children and adolescents.

A recent study has concluded that in adolescent and pre-pubertal girls, peak bone mass was effectively increased after exercise, especially after the bone loading exercises. They observed that two to four sessions of exercise for 30 min/day or less per week improved bone mass and that exercise provides lifelong protection against fracture in this age group.

In the present study, a significant decrease was noted in blood glucose, serum sodium and potassium levels, although they remained within the normal range. Percentage fall in blood glucose levels after one hour of exercise was significant. Physical activity increases glucose uptake into active muscles balanced by hepatic glucose production, with more dependence on carbohydrates to fuel muscular activity as the exercise intensity increases. The present finding is consistent with Kraemer et al., who showed a significant decrease in blood glucose values after exercise.

Serum sodium levels were significantly lowered after one hour of exercise. This reduction in serum sodium level can be attributed to the loss of sodium in sweat during exercise. Gerth et al. showed that serum sodium levels were significantly lower than normal in healthy volunteers during and after exercise.

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**Table 1: Comparison of routine biochemical parameters before and after exercise**

**Result**

| Parameter          | Before Exercise | After Exercise | P-value |
|--------------------|-----------------|----------------|---------|
| Blood glucose      | 84.83±8.60      | 74.17±4.90     | 0.001   |
| Serum sodium       | 122.67±5.17     | 114.17±4.92    | 0.005   |
| Serum potassium    | 22.09±2.38      | 20.83±1.92     | 0.008   |
| Serum urea         | 78.40±2.76      | 74.00±2.58     | 0.003   |
| Serum creatinine   | 52.00±3.14      | 48.17±2.92     | 0.007   |
| Serum uric acid    | 7.83±0.48       | 7.25±0.40      | 0.012   |
| Serum LDL          | 102.00±12.45    | 94.17±11.92    | 0.009   |
| Serum total cholesterol | 200.00±15.42 | 180.00±12.92  | 0.006   |

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Table 1 Comparison of routine biochemical parameters before and after exercise.

| Investigations           | 15 minutes before exercise | One hour after exercise | 24 hours after exercise | Statistical significance* |
|--------------------------|---------------------------|-------------------------|-------------------------|---------------------------|
| Serum urea (mg/dL)       | 19.30±3.52                | 20.20±2.95              | 19.96±3.02              | 0.525                     |
| Serum uric acid (mg/dL)  | 4.32±0.61                 | 4.36±0.51               | 4.07±0.96               | 0.260                     |
| Serum creatinine (mg/dL) | .66±0.14                  | .72±0.121               | .69±0.11                | 0.190                     |
| Serum sodium (meq/L)     | 140.26±6.86               | 135.40±5.61             | 139.60±5.66             | 0.005                     |
| Serum potassium (meq/L)  | 4.30±0.61                 | 4.08±0.561              | 4.50±0.75               | 0.047                     |
| Total cholesterol (mg/dL)| 153.53±23.03              | 150.73±22.07            | 150.66±21.71            | 0.851                     |
| Triglyceride (mg/dL)     | 116.96±30.46              | 115.50±31.47            | 115.46±31.44            | 0.978                     |
| HDL (mg/dL)              | 45.23±10.06               | 46.66±10.23             | 46.53±10.06             | 0.833                     |
| LDL (mg/dL)              | 82.73±17.97               | 80.00±18.18             | 80.13±17.64             | 0.802                     |
| VLDL (mg/dL)             | 25.73±8.05                | 24.60±7.80              | 24.16±7.64              | 0.727                     |
| Total bilirubin (mg/dL)  | .46±0.20                  | .56±0.17                | .51±0.15                | 0.107                     |
| AST (IU/L)               | 25.30±5.62                | 28.63±6.0               | 26.63±5.49              | 0.081                     |
| ALT (IU/L)               | 23.30±6.78                | 21.66±5.83              | 22.26±6.11              | 0.594                     |
| ALP (IU/L)               | 83.33±19.12               | 85.83±17.73             | 84.86±17.34             | 0.865                     |
| Total serum protein (g/dL)| 7.06±0.60                | 6.79±0.493              | 6.92±0.62               | 0.200                     |
| A:G ratio                | 1.61±0.26                 | 1.72±0.281              | 1.66±0.23               | 0.267                     |
| Serum calcium (mg/dL)    | 9.83±1.10                 | 8.98±0.873              | 9.36±0.71               | 0.002                     |
| Albumin (g/dL)           | 3.97±0.18                 | 4.09±0.244              | 4.01±0.195              | 0.091                     |
| Blood glucose (mg/dL)    | 93.10±4.92                | 89.13±5.05              | 92.00±4.96              | 0.008                     |

Decreased after exercise.[21] Potassium is the main electrolyte in the intracellular fluid of the body. It is stored with glycogen inside the muscle fibres and helps transport glucose into the muscle cells. A slight decrease in serum potassium can be due to sweating and exercise duration. However, prolonged exercise without any fluid intake with increased glycogen breakdown can contribute to increased serum potassium levels.[22] The alterations in other routine parameters like serum urea, uric acid, LDL and total cholesterol were insignificant. Long term effects on the bone with repeated exercise could not be determined in the present study. Further investigations are required to elucidate the physiological and clinical significance of the observed changes in routine biochemical markers.

Conclusion
The present study showed that moderate physical activity has a significant effect on selected biochemical parameters. However, effect of exercise on normal physiological functions and biochemical parameters can vary with different factors such as age & sex of subject, the intensity of exercise, duration of exercise & type of exercise. Further detailed studies with a larger sample size are recommended to support exercise programs.

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Ethics committee approval
The study was approved by ethical committee of institution with reference no- IEC/Th/17/Biochem/02.

Conflict of interest
There are no conflicts of interest to declare by any of the authors of this study.

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