

A COMPARATIVE STUDY OF SERUM CREATINE KINASE,
ASPARTATE TRANSAMINASE, UREA AND CREATININE
AFTER MUSCULAR EXERCISE

A THESIS

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INTRODUCTION AND AIM OF WORK

INTRODUCTION AND AIM OF WORK:

The effect of physical exercise on the levels of serum creatine phosphokinase and aspartate transaminase enzymes in normal subjects, suggested a relationship that might exist between their levels and the amount of muscular exercise or metabolic activity. Perhaps, increased tissue activity could result in an increased enzyme content within that tissue itself; and it may be due to extensive breakdown of tissue proteins as a result of muscular exertion.

Serum urea and creatinine may show marked rise due to protein catabolism during muscular exercise.

This work intends to outline the changes which might occur after muscular exercises in a statistical study.

SKELETAL MUSCLE AND ITS CHEMICAL STRUCTURE:

Skeletal muscle is made up of muscle fibres which are made up of fibrils. These fibrils are surrounded by an electrically excitable membrane, the sarcolemma, which is the functional unit of the muscle. It is repeated along the axis of a fibril at distances of 2.5 μm . ($23,000\text{\AA}$). When the myofibrils are examined by electron microscopy, alternating dark and light bands (A bands and I bands) Fig. (1), can be observed. The central region of the A band (The H zone) appears less dense than the rest of the band. The I band is bisected by a very dense and narrow Z line, the distance between two Z lines is the sarcomere, Orten (1975). When a cross-section of a myofibril is examined in an electron micrograph, it appears that each myofibril is constructed of 2 types of longitudinal filaments. One type confined to A band (the thick filament), the second filament (the thin filament) lies in the I band.

The muscle fibrils are divided into individual filaments which are made up of contractile proteins (Myosin, Actin, Tropomyosin and Troponin). Myosin forms the thick filaments and is the most abundant muscle protein, it is a globulin, which is soluble in dilute

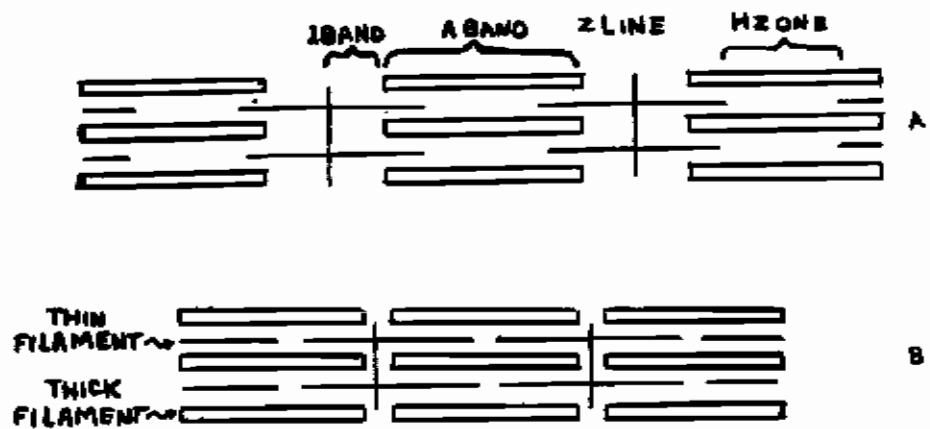


Fig. (1)

Arrangement of filaments in striated

muscle. A: Extended

B: Contracted

salt solutions but insoluble in water. Actin is a globulin of M.W. 80,000 which is the major constituent of the thin filaments and is responsible for the striations in striated muscle, Murray (1974) and Stryer (1975).

The fundamental reaction in muscle activity is the interaction of actin and myosin; in the absence of calcium ions, the interaction is inhibited by troponin and tropomyosin which are located in the thin filaments of the muscle.

When the motor nerve of the muscle is excited, it brings about a release of Ca^{2+} from the sarcolemma, the released calcium binds to the (TPC) portion of the troponin complex, producing conformational changes which are transmitted to tropomyosin and then to actin. This, permits actin to interact with myosin with the resultant muscular contraction, accompanied by hydrolysis of adenosine triphosphate acting as an energy source, Huxley (1971). In the resting state, mammalian muscle contains 4-6 times as much phosphocreatine as ATP.

The transfer of high energy phosphate from creatine phosphate to adenosine diphosphate (the Lohman reaction) is catalyzed by the enzyme creatine kinase (creatine

phosphokinase, CPK). The reaction is reversible, so that resynthesis of creatine phosphate can take place when ATP titer becomes available, such as during the recovery period which follows a period of muscular contraction, Huxley (1972).

THE PHYSIOLOGY AND METABOLIC CHANGES OF MUSCULAR EXERCISE:

Since muscular exercise not only involves the neuro-muscular coordination of bodily movements but also many other complex adjustments of metabolism, respiration and circulation; so, practically the entire organism may be involved in the adjustment of man to work. The actual coordination of movement depends upon the nervous system, the release of energy by the contracting muscles and the processes of excitation and conduction require many complex physical changes as well as both anaerobic and oxidative chemical reactions.

An exercising man has to supply his muscles with metabolic products from the lungs, liver, and the intestines by the way of the circulatory system and maintain such chemical homeostasis by transporting the metabolites of work to the lungs, kidneys and skin for excretion, Robinson (1958).

Studying the effects of exercise on man, the work may be classified in terms of the type of activity involved and the intensity of the work.

Dill (1936) has classified work on the basis of the rate of energy expenditure or the oxygen consumption of the men performing the work.

Moderate work, which covers most of the daily jobs of the workers, requires an average hourly energy expenditures up to about 3 times the resting metabolism of man. For an average man, weighing 70 Kg., this would entail an oxygen consumption up to about 0.8 L./min. and energy metabolism of 4 K cal./min. or 1,900 K cal. in 8 hr. of work and 3,800 Kcal in 24 hr .

Hard work, according to Dill, describes work rates with an energy expenditure of 4 to 8 times the basal metabolism and oxygen consumption of 1 to 2 L./min. This range, includes most of the manual jobs of heavy industry, building, mining, agriculture and war. This hard working man would expend a total of 6,200 Kcal during the 24 hr. day.

Dill's category of maximal work describes work rates in which man can not maintain a steady state of energy output for long and even greater rates in which the steady state is never reached. Exhaustion may result from hyperpyrexia, hypoglycaemia, and inadequate oxygen supply in most types of intense work, such as competitive races, in which, the anaerobic reserves of the muscles are called upon. In the last category, exhaustion is associated with the accumulation of metabolites of anaerobic metabolism in the muscles and blood.

When a man starts walking or running on the treadmill, he immediately begins to expend energy at a rate that is proportional to the rate of movement. Oxygen consumption, beginning at the resting level, is rapidly accelerated in the first 2 min. of work and levels off at a steady rate after the second minute. As the work is continued at a constant rate, the oxygen consumption remains constant. During recovery following work, oxygen consumption declines as a logarithmic function of time. The steady state of oxygen consumption during constant submaximal work is just sufficient to provide (by oxidation) the energy of basal metabolism plus all of the energy required to carry on the work. The maximal

oxygen consumption of a man, represents his maximal rate of aerobic energy release for work, and it is attained in the second or third minute of any exhausting work, it does exceed his maximal capacity for aerobic metabolism.

Following a period of work, a man's oxygen consumption does not return immediately to the prework level. It declines as a logarithmic function of time and thus, during recovery the man consumes more oxygen than his resting requirement. This excessive oxygen consumed during recovery was termed the "Oxygen debt" by Hill (1924). Diminution of O_2 debt ranges from 100 ml. in moderate work to 250 ml. in exhausting work which is not really a part of the metabolic energy debt and it is paid off in the first minute of recovery. In maximal or exhausting work, the time of recovery and the O_2 debt are related to the degree of exhaustion reached and thus to the intensity of the work and its duration (Schneider, 1964).

CLASSIFICATION OF EXERCISES:

Alway (1970), considered that, running up to 800 meteres is a mild type of exercise, up to 1,500 meteres is a moderate type while exceeding this distance is a severe type of exercise.

Pernow et al, (1971), suggested that exercises were two types, aerobic and anaerobic. By the aerobic, he means that there is continuous respiration during exercise while in the anaerobic type, there is stoppage of respiration. Aerobic exercise associates severe type of exercise (Long duration and distance), while anaerobic exercise occurs in moderate exercise (short duration and distance) and he stated that the subject can not perform any type of exercise anaerobically more than 3 minutes.

Richard (1974) classified running (as a type of exercise), into grades, according to the distance, short distance up to 400 meters, middle distance up to 5,000 meters and more than this it is considered as a long distance. Examples of long distance running are long distance races, Marathon and cross country races. He concluded that the longer the stretch the harder the effort, and considered short distance (sprints) to be mild effort, middle distance as moderate and long distance as severe effort.

Johnson et al, (1975) correlated running as a type of exercise (according to the source of energy) and he suggested that there are two classes of exercise. The first class is the (light exercise) in which glucose and