

EXERCISE INDUCED SERUM ENZYME CHANGES IN UNTRAINED SUBJECTS

D.J. PARIKH AND N.L. RAMANATHAN*

National Institute of Occupational Health,

Meghani Nagar, Ahmedabad—380016

Summary: The serum enzyme values (GOT, GPT, LDH and Aldolase) of 13 fit healthy volunteers were determined before and after physical effort of a moderate grade of 3.9 Kcal/min. The pulse rate pattern of the subjects during the exercise of climbing up and down a staircase for 30 minutes and during a 10 minute recovery phase was also recorded. The pulse pattern was in no case in excess of 150 bpm and full recovery was achieved within 10 minutes indicating that the exercise was moderate.

The serum enzyme values after the exercise were raised. The difference between the exercise and rest values of the four enzyme activities were significant at the 1% level. It was observed that the raised enzyme activity level dropped to normal levels within 24 hours after the exercise. Large individual variations in the rise of these enzyme levels after exercise were observed and hence it is difficult to quantify the phenomenon. Consequently the value of serum enzyme levels after the exercise as a practical index of physiological strain is limited.

Key words: serum enzymes physiological strain exercise

INTRODUCTION

Cell damage in body tissues cause alteration of enzyme levels in serum. Determination of serum enzyme values is, therefore, of considerable diagnostic value in clinical medicine. Enzymes such as Glutamic Oxalacetic Transaminase (GOT), Glutamic Pyruvic Transaminase (GPT), Lactic dehydrogenase (LDH) and Aldolase are diagnostic indicators in pathological conditions like myocardial infarction, muscular dystrophy, hepatitis, and neuromuscular diseases (13,14).

These enzymes are also sensitive to muscular exercise, after a bout of which their levels in serum show significant rises, especially in persons unused to much physical activity. Such rises have been attributed to greater cellular permeability by Fowler *et al.* (5), Garbus *et al.* (6) and Chowdhury (2). It is interesting to note that in runners after completing a marathon, the enzyme levels shot up to nearly double the normal values (4,7,12).

Fowler *et al.* (5) have conducted a study of the exercise effects on serum enzymes in trained and under-trained subjects walking on a treadmill. Chowdhury (2) has suggested that the serum enzyme values could be utilized as a preplacement examination test for selecting workers for jobs involving severe muscular effort. Parikh and Ramanathan (9) observed a trend of rise in the enzyme levels of foundry workers, who are exposed to considerable heat stress.

In the present study, the serum enzyme changes in untrained subjects induced by the exercise of stairclimbing has been determined and reported.

*Present address : Director (Environmental Planning), Department of Science and Technology, Technology Bhavan, New Delhi-110029.

MATERIALS AND METHODS

Subjects: Professional blood donors were chosen for this study, since repetitive blood samples could be drawn willingly from them. From a batch of about 20 volunteers, thirteen were willing to participate in the experiment after medical screening for fitness and health. In the medical examination, care was taken to exclude subjects who may have conditions like inflammation, liver and muscular abnormalities, which might affect the enzyme levels. Their age ranged from 20 to 40 yrs, and their mean height weight and body surface area were respectively 162 cm (± 5), 48.3 kg (± 6.2), and 1.47m² (± 0.07). They were briefed on the nature of the exercise test and allowed to train themselves in preliminary trials, till they could perform the test satisfactorily.

Exercise test :

The exercise test administered was climbing up and down a staircase for a period of 30 minutes. These exercise tests were conducted in the summer months, May and June. The thermal conditions during the experiments were measured and resulted in an average WBGT of 28.5°C (range 27.2 to 30.4°C).

The flight of stairs had 26 steps of riser height of 14.5 cm, with one turn at the midway landing. The mean time for ascending the flight of stairs by the subjects at their normal speed was 17 seconds and for descending 15 seconds. The speed of ascent and descent were therefore, 13.3 and 15.1 m/min respectively. The metabolic cost of climbing the stairs at this speed was computed according to the formula of Ramanathan and Kamon (11) as 5.88 Kcal/min, which for Indian subjects may be considered as heavy as per the classification of Ramanathan *et al.* (10). The metabolic cost of climbing down the stairs is one third of the cost for climbing up (11), that is 1.96 Kcal/min, a light grade of exercise. The mean energy cost of the exercise, therefore, may be taken as 3.92 Kcal/min, which is a moderate grade of exercise for Indians according to the above classification.

Parameters observed :

Pulse rate : The pulse rate of the subjects, after 15 minutes at rest before exercise, during climbing at intervals of five minutes for which the subject was stopped for 30 seconds, immediately on completion of the exercise period, and during a 10 minute recovery phase was determined by palpation of the radial pulse using a pulse timer. The pulse pattern from the rest to recovery phases was plotted.

Serum enzymes Levels : The enzymes determined in this investigation were SGOT, SGPT, LDH and Aldolase, using standard methodology described in Bohringer Biochemical Test Handbook (1). For this purpose, seven ml of cubital vein blood was drawn from each subject both at rest and immediately after exercise, taking care to avoid haemolysis. The blood samples were allowed to clot for 2 hours at room temperature, centrifuged for 15 min at 2,000 rpm for separating the serum. Enzyme activity was determined immediately after centrifugal separation

of the serum. The enzyme activity levels were expressed as milli-units per *ml* of serum, corresponding to 2 Wroblewski units, for SGOT, SGPT and LDH. For Aldolase, which has a high temperature coefficient of variation, the value was expressed at 25°C.

Procedure:

On the first day of the experiment, the resting levels of serum enzyme activities of the subject was determined. On a subsequent day, the exercise test was administered and blood drawn at the conclusion of the exercise for enzyme determination. After an interval of four days, the exercise test was repeated for confirmation of the results. The two exercise runs have been differentiated as Exercise-I and Exercise-II.

In six subjects, serum enzyme activities were determined 24 hrs after the final exercise run to ascertain whether the levels had returned to normal values.

RESULTS AND DISCUSSION

The pulse rate pattern of two subjects from rest to recovery phase is presented in Fig. 1. The other subjects also had similar patterns. All the subjects recovered in ten minutes or earlier

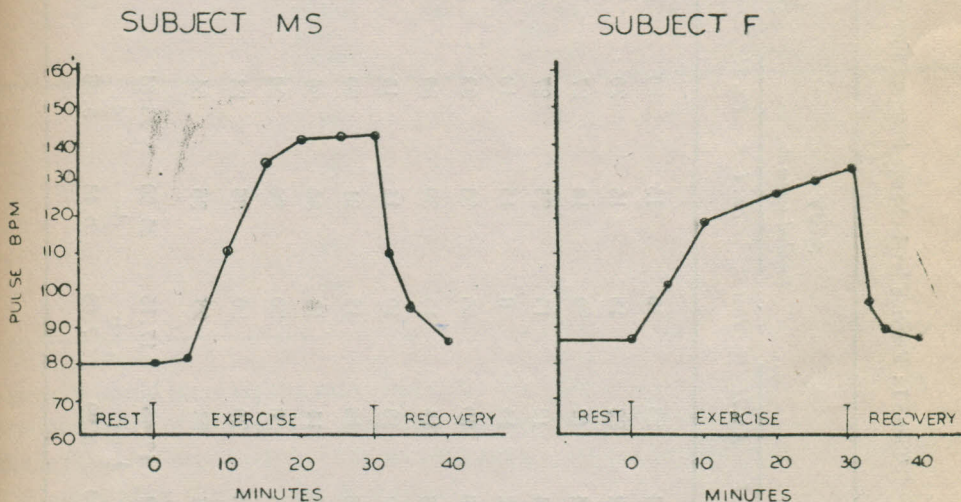


Fig. 1: Pattern of pulse rate of untrained subjects during stairclimbing and recovery.

after the exercise and the pulse rate returned to the resting value. The maximum pulse rate was observed in the last few minutes of the exercise and its value ranged from 100 to 150 bpm. The mean maximum value of the pulse rate for all subjects for Exercise-I and Exercise-II were 124 and 117 bpm respectively, which again confirms that the work performed was of a moderate grade (3) and that it was not particularly stressful (8).

The mean and standard deviation of the enzyme level values at rest, and after Exercise-I and II are given in Table I. The exercise values are higher than the rest values for all the four

TABLE I: Enzyme level change in serum after exercise in untrained subjects.

Subject and Code No.	SGPT mu/ml serum			SGOT mu/ml serum			ALDOLASE mu/ml serum			L.D.H. mu/ml serum		
	Rest	Ex. I	Ex. II	Rest	Ex. I	Ex. II	Rest	Ex. I	Ex. II	Rest	Ex. I	Ex. II
1. RAT	12	24	23	18	15	20	1.4	2.3	2.5	143.2	248.3	229.2
2. RAM	14	12	28	18	15	20	1.4	2.9	2.5	124.1	143.2	143.2
3. BAL	10	14	12	20	18	27	1.1	2.9	2.7	152.9	191.0	191.0
4. NAN	7	14	12	15	25	27	1.1	2.9	2.7	162.3	172.0	133.8
5. PRA	5	12	14	8	15	18	0.7	3.4	3.2	47.8	191.0	191.0
6. ABU	16	18	19	35	33	33	1.4	3.8	3.6	95.5	229.0	172.0
7. YUS	5	18	14	10	30	30	1.1	2.7	2.9	133.8	143.2	133.8
8. MS	10	20	18	10	15	15	1.1	1.4	2.0	133.8	143.2	152.9
9. SHA	7	16	16	13	31	30	0.9	3.6	2.9	152.8	162.3	143.2
10. F	7	16	14	13	30	30	1.8	3.2	2.7	95.5	181.5	172.0
11. CHI	10	16	8	20	30	26	1.4	2.9	2.7	47.8	95.5	114.5
12. UDA	14	23	25	20	36	23	1.8	3.4	2.9	57.3	181.5	172.0
13. AMA	14	23	24	23	36	34	1.8	2.3	2.0	47.8	105.0	133.8
Mean \pm S.D.	10.07 \pm 3.7	18.92 \pm 5.43	17.46 \pm 5.99	17.15 \pm 7.09	25.30 \pm 8.48	25.61 \pm 5.96	1.3 \pm 0.34	2.90 \pm 0.63	2.71 \pm 0.42	107.27 \pm 44.29	168.20 \pm 43.50	160.18 \pm 31.47

enzymes. The differences between the exercise values and rest values of enzyme activities are significant at the 1% level. No significance, however, was observed between the enzyme activity values for Exercise-I and Exercise-II. The percentage increase in enzyme activities after exercise over the rest values varied between subjects. The percentage increases were sometimes as much as 200 to 300 percent. The mean percentage rises for the four enzymes were: SGOT - 65.4%, SGPT - 90.2%, LDH - 83.8% and Aldolase 135.8%. However, the large individual variations in the rise of these enzyme levels after exercise, render it rather difficult to draw generalized conclusions from the present data.

The enzyme activity levels 24 hours after the exercise in the five subjects studied (Table II) showed that no residual increase in enzyme activity remained This indicates that the change

TABLE II: Enzyme activity levels 24 hours after the exercise in the untrained subjects.

Subject and Code No.	S.G.P.T. mu/ml serum		S.G.P.T. mu/ml serum		ALDOLASE mu/ml serum		L.D.H. mu/ml serum	
	Rest	24 hrs after exercise	Rest	24 hrs after exercise	Rest	24 Hrs after exercise	Rest	24 hrs after exercise
6 ABU	16	14	35	30	1.4	0.9	95.5	95.5
7 YUS	5	5	10	15	1.1	1.1	138.8	143.2
8 MS	10	12	10	13	1.1	0.9	133.8	133.8
9 SHA	7	10	13	15	0.9	0.9	152.8	133.8
10 F	7	10	13	15	1.8	1.4	95.5	95.5

during exercise could increase the rate of enzyme efflux from the muscle, presumably by increasing the permeability of the cell (2), and thus attains normal values in the tissues quickly. Chowdhury (2) has reported that the serum enzyme values recover the pre-exercise level in only 30 minutes after the exercise is stopped.

Since the enzyme level recovers to normal values, no residual cell destruction could have occurred due to such moderate exercise. The rise in the level of the enzymes in circulating blood is therefore only indicative of increased cellular permeability. Apart from this, the post exercise decrease in blood volume, increase in serum protein and potassium and depletion of glycogen may also influence the efflux of enzymes from the muscle.

The biochemical and physiological responses of the body may be related to stress due to exercise, heat or altitude hypoxia. Such changes during exposure to these stresses may cause the observed serum enzyme changes. Nevertheless, the considerable inter and intra-individual variations in the serum values of the enzymes as well as the uncertainty regarding the mechanisms

effecting such changes, render it difficult to quantitate the phenomenon and consequently limit its value as a practical factor of the physiological strain due to the exercise.

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