



ORIGINAL RESEARCH PAPER

Medical Biochemistry

EXERCISE INDUCED OXIDATIVE STRESS AND ADAPTATION TO OXIDATIVE DAMAGE

KEY WORDS: Exercise, free radical

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ABSTRACT

Aim: It has been established that exercise induced oxidative stress and causes adaptation in antioxidant defense. The purpose of the present study was to observe the effect of different duration regular exercise on free radicals generation. **Hypothesis:** After thoroughly searching all the available scientific literature it was hypothesized that regular exercise may have an influence on free radical production. **Methods:** Thiobarbituric acid reactive substances (TBARS) were measured for detecting free radical production in the different duration regular exercise group. For statistical analysis mean, SD, and “Mann-Whitney- U test” were calculated through SPSS software package. Results: TBARS levels were higher in highly trained group in comparison with the moderately trained group. Plasma TBARS was significantly higher in regular exercise group than the control group. **Conclusion:** Regular moderate exercise may favorably alter Free Radical production.

Introduction

Free radicals are atoms or groups of unstable atoms with odd electron and are formed when oxygen interacts with certain molecules. Once formed these highly reactive radical can start a chain reactions. The chief danger comes from the damage they can do when they react with important cellular component such as DNA or the cell membrane. Cells may function poorly or die when this occur. To prevent the free radical damage the body has a defense system of antioxidants.

Cell continuously produce free radical and reactive oxygen species as a part of normal metabolic process. In normal condition body produce required amount of antioxidant for neutralize the free radical production. An elevated metabolic rate as a result of physical exercise can dramatically increase oxygen consumption by the body. These increasing oxygen uptake is associated with rise in the production of free radical up to 2-5% of the total oxygen consumption. The objective of the present study was to observe the effect of regular exercise on free radicals generation on different sports training groups. Another purpose of this study was to observe the magnitude of changes of the above variable in different training group.

Group	Age	No of subject	Practice Hour
Senior exercise (SE)	50-60 yrs.	6	1-2 hours
Senior control (SC)	50-60 Yrs	5	Non regular

METHODS

Subjects

In this study data collected from three experiments (I, II & III). The detail description of the subjects and training schedule are presented below.

Experiment – I

In experiment –I, the data were collected from six height, weight matched male student volunteers (20-23 years) randomly chosen from Department of Physical Education, Visva- Bharati. Among them three subjects were practice 3-4 hour/day; (highly trained group) and the rest three were form practice- 1-2 hour/day (moderately trained group).

Group, Age, Number of subjects, Practice Hour of Experimental-I

Group	Age	No of sub	Practice Hour
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Group	Age	No of sub	Practice Hour
Highly Trained Group (H.T.G)	20-23 yrs.	03	3-4 hours
Moderately Trained Group (M.T.G)	20-23 Yrs	03	1-2 hours

In experiment –II, six senior citizen were randomly selected from the exercising community and five subjects from the control from non regular exercise habit community. All of the subjects were the employee of the visva bharti university.

Group, Age, Number of subjects, Practice Hour of Experimental –II

In experiment –III, nine male albino rats were taken as the subjects. From them three subjects were chosen for regular exercise group. Among the control group (N- 6) three subjects were chosen again as the single bout acute exercise group in the day of final experiment.

Group, Age, Number of subjects, Practice Hour of Experimental –III

Group	Age	No of sub
Regular exercise. Group(EXP)	06 month	03
Single bout acute exercise Group(SB EXP)	06 month	03
Control Group(CON)	06 month	03

In experiment I, II the experimental group male subjects participated in their own schedule according to their nature of games with the help of Physical Education Teacher or coach.

In experiment - III, the experimental group male albino rats practiced according to the following schedule.

Exercise protocol for experiment –III Group



Blood sampling:

All players and healthy control subjects were recruited into the study after obtaining their informed consent. After a 12-h overnight fast, blood samples were drawn from the antecubital vein.

Biochemical measurement

Principle

This TBA method is based on the acid catalyzed decomposition of lipid peroxidase to malandialdehyde (MDA) which reacts with thiobarbituric acid (TBA) to form a red aromagan. This is quite sensitive method.

Protocol

Place TBA reagent *1 (2 ml) and sample (1 ml) in a tube (10 ml) with cap.
Heat at 1000C in a water bath for 15 min.
Cool in ice-cold water
Centrifuge at 300 rpm for 10 min
Measure the absorbance of supernatant at 535 nm.

Calculation

Calculate the hydro peroxide concentration using the molar absorption coefficient = 1.56 X 105 m-1 Cm-1 at 535 nm .

Group	No of Sub	Duration of Exercise	Practice Hour	Mode of Exercise
Regular exercise. Group	03	10 weeks	Morning- 1 hour Evening - 1 hour	Improvised treadmill
Single bout acute exercise Group	03	Experiment day only	2 hours	Improvised treadmill
Control Group	03	Nil	No exercise	Nil

*TBA reagent: TBA reagent is prepared by dissolving TCA (15 g) in water and adding TBA (0.375 gm), Hcl (1m, 25 ml), [and a solution at 2,6. di-tret-bufyl-4-methylphenol (40 mg) in ethanol (22 ml)] The solution is finally distilled to 100 ml distilled water. Because the sample is treated with TBA reagent at high temperature for 15 min, it is advisable to add on antioxidant to minimize the formation of hydro peroxides during analysis.

Ref: Buege et al (1978)

Statistical Procedure

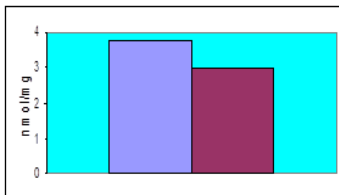
For statistical analysis standard procedures had been adopted. Mean and SD were first calculated and Mann-Whitney tests (U test) was conducted to determined the degree of differences between two means.

RESULTS :

Experiment-I

The mean and SD of resting and fasting plasma TBARS level of two groups (HTG & MTG) are presented in the table and graph no-1

Table & Graph no-1



TBARS (nmol/mg)	HTG	MTG
MEAN	3.77	2.96
SD	0.04	0.05

Mean TBARS of HT group was 3.77+0.04 nmol/mg protein where as MT group was 2.96+ 0.05 nmol/mg protein. TBARS level was found higher in the HT group but the diffreance were not significant in .05 level.

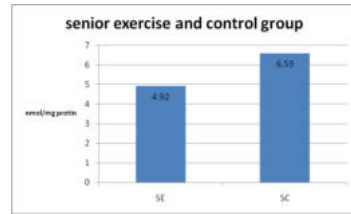
TBARS (nmol/mg)	CONT	EXPE	CONTROL	S B EXER

MEAN	11.56	8.66*	11.56	11.84
SD	0.2	1.4	0.2	0.96

Experiment-II

The mean & SD of TBARS value of Young experimental and control are presented in the table & graph no-2

Table & Graph no-2



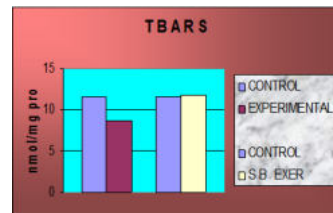
The resting & fasting plasma TBARS level in senior group, it was 4.92+ .25 nmol /mg in SE and 6.59+ / .58 nmol /mg in SC. It was observed that both regular exercise group TBARS value was significantly lower than the control group.

Experiment-I

Experiment-III

The mean & SD of plasma TBARS level three different group of rats are presented in table & graph no-3.

Table & Graph no-3



The mean plasma TBARS of the experimental group and SB exercise group were 8.66+1.4 nmol/mg, 11.84+0.96 nmol/mg respectively, where as control group was 11.56+/-0.2 nmol/mg. It was observed that experimental group was significantly lower (P <0.05) than control group in TBARS variable. But after single bout of exercise TBARS level was slightly increased than the control group.

TBARS (nmol /mg)	SE	SC
MEAN	4.92*	6.59
SD	.25	.58

DISCUSSION

Physical exercise may be associated with a many fold increase in whole body oxygen uptake and free radical production. The rise in oxygen utilization during physical exercise may lead to increase in metabolic leakage of damaging free radicals of oxygen from the mitochondria into the cytosol, resulting in the formation of lipid peroxide (Davies et al, 1982, Dillard et al , 1978, lowilin et al 1987, Pincemail, 1990).Several studies reported that single bouts of exercise increased TBARS blood levels (Davies et al 1982, Hartmann et al 1995, Koska et al 2000, Miyazaki et al 2001). Vincent et al (2002) stated that resistance type of exercise can reduce lipid per oxidation, provide protection against oxidizing agent in vitro and also provide a cross protection against the oxidative stress generated by aerobic exercise. Steinberg et. al. (2002) reported that habitual physical exercise can favorable affect antioxidant potential and prevent lipid peroxidation in healthy subjects. Kanter et al.(1998) reported increases in plasma TBARS (~70%) following an extreme endurance event (50-m run) in professional athletes. Similarly, Child et al found increase in TBARS of approximately 40% immediately after half marathon.

Not all studies reported increase in TBARS in response to exercise. Moderately trained subjects who ran for 2.5 h on a

treadmill showed no change in plasma TBARS. (Davies et al 1982, Kanter et al 1998), Similarly there were no documented change in plasma TBARS in athletes at rest, or before or after 4 weeks of high training(Dernbach et al 1993) found no change TBARS after repeated isometric exercise.

Present research shows that, in experiment- II, TBARS level were higher in highly trained group in comparison with moderately trained group. Plasma TBARS was significantly higher in YE group but it was in significantly lower state in SE group in experiment-IIA. In experiment –IIB Plasma TBARS level was found higher in the football & athletics groups where as yoga and WT groups were observed lower than the control group.

CONCLUSION

High level exercise may increase plasma TBARS level which was reflected by HTG, YE & SB exercise group. YE group was shown significantly higher value than control. In experiment - IIB free radical variable mean resting TBARS level was found higher in the Football and Athletics groups where as Yoga and Weight Training groups were observed lower than the control group.

RECOMMENDATION

An interested researcher may find enough scope for further study from the findings of present research hence recommended for further study. The study may be conducted on a large sample and same experimental study may be conducted on female subjects

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