

RESEARCH ARTICLE

Study of oxidative stress in smokers by estimating serum superoxide dismutase

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ABSTRACT

Background: Consuming tobacco is a major addiction worldwide. Smoking tobacco in the form of cigarette or beedi is prevalent in both males and females. Smoke of cigarette and beedi contains more than 2000 different toxic materials. These toxic materials produce local as well as systemic tissue damage. The damage caused by this smoke is mostly due to the oxidative stress produced by the free radicals due to smoking. **Aims and Objectives:** The aim of the study is to find out the level of oxidative stress in smokers and compare it with the non-smoking subjects of the same age group. Furthermore, this study aims to find out relationship of pack-years of smoking with the oxidative stress in the smokers. **Materials and Methods:** A total of 30 smokers having a history of more than 10 pack-years of smoking and 30 non-smoker subject of the age group of 40–70 years of age with no major illness were selected for the study. The serum superoxide dismutase (SOD) enzyme level was measured. The estimated SOD level was compared in both the groups. **Results:** When both the groups were compared for the serum SOD level, it was found that the SOD level was significantly low in the smokers as compared to non-smokers. Furthermore, there was a significant negative correlation between the pack-years of the smoking and the serum SOD level. **Conclusion:** The result of the study shows that smoking enhances oxidative stress by decreasing the level of lifesaving antioxidant enzymes in the body. This decrease in levels of antioxidant enzymes makes the smokers prone to various diseases such as coronary artery disease, chronic obstructive pulmonary disease, and cancers.


KEY WORDS: Smoking; Superoxide Dismutase; Oxidative Stress; Pack-years

INTRODUCTION

Tobacco is one of the most common addictions prevalent worldwide. Tobacco can be consumed in various ways. A common way to consume tobacco is by smoking cigarettes and beedies. A research showed that there are nearly 1.1 billion

smokers present across the world making smoking one of the major addictions in the world.^[1] Cigarette smoke contains more than 10¹⁰ toxic chemicals such as nicotine, ozone, benzene, phenols, carbon monoxide, polyphenols, formaldehyde, acetaldehyde, acrolein, nitrogen oxides, ammonia, and hydrogen cyanide.^[2,3]

These toxic reagents produce free radicals which are reactive oxygen species and nitrogen species such as superoxide, hydroxyl, and peroxide radicals. These free radicals directly as well as by producing inflammatory responses cause oxidative stress to various tissues. This oxidative stress leads to complications such as chronic obstructive pulmonary disease (COPD) in respiratory system, coronary artery disease

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(CAD) in cardiovascular system, lung cancer, oral cancer, and atherosclerosis by the involvement of vascular endothelium.^[4] It has been seen that more the number of cigarettes smoked per day more will be chanced of complications.^[1]

Body responds to oxidative stress produced by smoking by forming some scavenging antioxidant enzymes such as superoxide dismutase (SOD), glutathione peroxidase, and catalase. These enzymes inhibit the oxidation of DNA, proteins, and lipids and control the oxidative stress.^[4]

The aim of the present study was to find out the oxidative stress of the smokers by measuring the serum SOD level and compare it with the normal non-smoking subjects and to find if there is any significant alteration in oxidative stress of the smokers.

Aims and Objectives

The aim of the study is to estimate the serum SOD level in non-smoker subjects and smokers of the same age group and compare the oxidative stress of both the groups and to correlate the oxidative stress of the smokers to the pack-years.

MATERIALS AND METHODS

The present study was carried out in the physiology department in assistance with the biochemistry department of a government medical institute. Permission of college ethical committee was taken before starting the study. Written consent was taken from all the subjects included the study.

Thirty non-smoker healthy subjects and 30 smokers of the age group of 40–70 years were selected from the outpatient department of the institute.

The smoker subjects of the age group of 40–70 years with a history of smoking of at least 10 pack-years (A pack-year means 20 cigarettes or 80 beedies smoked each day for 1 year)^[5] without any major illnesses such as diabetes, hypertension, or cardiac disorders were selected for the study. Control subjects were non-smoker subjects of the age group of 40–70 years without any major illness were included in the study.

After selecting the subjects, the serum SOD levels were measured. For that, venous blood samples were taken from both the groups. For smokers, the blood sample was taken after 12 h of last smoke to delineate the effect of acute smoking.

Serum SOD levels were measured with the Marklund and Marklund modified by Nandi and Chatterjee.^[6,7] Normal level of SOD in serum is 2.93–3.71 units/ml. The mean value of SOD and the standard deviation was calculated for both the groups. The means of both the groups were compared using an “unpaired *t*-test” and statistical significance was

calculated. A correlation test was also applied to find out if there any correlation between the pack-year and serum SOD level.

Statistical calculations such as mean, *t*-test, and correlation were done using GraphPad Prism software (version 6.01) and Microsoft Excel software.

RESULTS

From Table 1, it was found that the mean level of serum SOD was less in smokers when compared with non-smokers. Statistically highly significant difference was found using “unpaired *t*-test” ($P < 0.001$). Table 2 shows that there is a statistically significant correlation between the pack-years of smoking and serum SOD level. Negative “*r*” value denotes that this correlation is negative, i.e., if the number of pack-years increases, then the value of the SOD level decreases.

DISCUSSION

In the present study, the serum levels of enzyme SOD in the 30 smokers with a history of more than 10 pack-years of smoking were measured and compared with 30 non-smokers. It was found that the level of SOD was low in smokers (Mean \pm SD = 2.50 \pm 0.45) as compared to non-smokers (Mean \pm SD = 3.01 \pm 0.23). This decrease in SOD was statistically significant. On correlating the pack-years to serum SOD level using Pearson’s correlation, the “*r*” value was found to be -0.584 and $P = 0.0032$. Thus, a significant negative correlation was found between the pack-years and the serum SOD levels in smokers. This suggests that as the number of the pack-years increases, the serum SOD level decreases. This means that more oxidative stress is produced if the pack-years of smoking increase.

Smoking is known to cause an imbalance between the oxidant and antioxidants in the body. Various toxic harmful substances in the smoke such as nicotine lead to the generation of oxygen and nitrogen-induced free radicals. These radicals are neutralized by free radical scavenging antioxidant system of the body which includes SOD, glutathione peroxidase, and catalase.^[4] These antioxidant enzymes, however, get exhausted over a period of time which produces oxidative stress in the body.

Similar study was performed by Gordana *et al.* in smokers with CAD. They measured SOD, glutathione peroxidase, and catalase level in the patients of CAD and found that

Table 1: Comparison of serum SOD level in smokers and non-smokers

Antioxidant enzyme	Smokers	Non-smokers	<i>P</i> -value
SOD level (U/ml)	2.50 \pm 0.45	3.01 \pm 0.23	<0.001*

**P*-value: Statistically highly significant, SOD: Superoxide dismutase

Table 2: Correlation between the duration pack-years of smoking and the serum SOD level in smokers

Pack-years	Serum SOD (U/ml)	Pearson's correlation coefficient (r value)	P-value
16.02±3.20	2.50±0.45	-0.5206	0.0032*

*P-value: Statistically significant, SOD: Superoxide dismutase

the level of SOD is very low in the patients of CAD with a history of smoking in the past.^[4] Gavali *et al.* in their study on COPD patients had similar finding that the serum SOD level decreases in patients of COPD with a history of smoking.^[8]

van der Vaart *et al.* in their study on acute effects of smoking on oxidative stress concluded that even acute smoking may cause oxidative stress in the smokers.^[9] Saha *et al.* in their study also confirmed that long duration of smoking causes more deleterious health hazards as compared to lesser duration of smoking. Further, they concluded that even passive smoking exposure is as dangerous as the primary smoking.^[1] Barreiro *et al.*, in their study, found that oxidative stress due to smoking may cause skeletal muscle dysfunction, especially diaphragm which may worsen the COPD condition in the smokers.^[10] Lipid peroxidation by oxidative stress produces ethane, which can be seen in schizophrenia patients also, so smoking may cause behavioral changes as concluded in a study of Puri *et al.*^[11] Smoking may also cause auditory disturbances by inducing hypoxia in the auditory nerve.^[12] There are also evidences that smoking causes raised intraocular pressure,^[13] lung cancer,^[1] etc.

Thus, smoking is a major addiction as well as it is a major public health problem. It is associated with many health problems such as CAD, COPD, cancer, behavioral changes, and ocular and auditory complications. These health problems mostly occur due to oxidative stress produced by the smoking and imbalance of antioxidant enzymes in the body. Secondary smoking also poses same risks as primary smoking. Thus, it is important to conduct more studies with larger sample size and increases the community awareness against smoking.

CONCLUSION

Smoking is a major public health issue. It is associated with oxidative stress by forming the oxygen and nitrogen free radicals which reduces the scavenging antioxidant enzymes like SOD. This puts the smokers at risk of various diseases such as CAD, COPD, and cancer.

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