

Original Research Article

A research on effects of tobacco dust on status of total thiol in bidi industry workers

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ABSTRACT

Background: Bidi industries workers handle tobacco ingredients during rolling of bidi and inhale tobacco dust and volatile component are present in the work environment. Tobacco absorbed by the body in tremendous amount leading to preventable cause of disease, disability and including chronic obstructive pulmonary disease, cardiovascular, carcinomas, premature death exposure among bidi workers. The goal of this study was to occupational exposure of tobacco dust on status of total thiol level in bidi workers.

Methods: Healthy controls - 30 subjects and 90 bidi workers were further subdivided on the basis of work experience in years as, Group-I: 5-9 years (30 subjects), Group-II: 10-14 years (30 subjects), Group-III: 15-19 years (30 subjects). Authors are measure total thiol concentration and thiobarbituric acid reactive substances. All the biochemical parameters measured in study group subjects were statistically compared with those estimated in controls.

Results: Highly significant decrease in levels of total thiol was found in all groups of bidi workers as compared to healthy controls ($p < 0.001$) and serum thiobarbituric acid reactive substances levels were significantly elevated in all groups of bidi workers when compared with healthy controls ($p < 0.001$). The study groups indicates that decline the total thiol gradually progresses with increase in exposure period to tobacco dust.

Conclusions: The study groups showed that decrease the total thiol level and increases the thiobarbituric acid reactive substances in all groups of bidi workers compared with healthy controls.

Keywords: Bidi workers, Thiobarbituric acid reactive substances, Total thiol

INTRODUCTION

There are several chemical compounds present in the environment that cause toxicity and others that are extremely hazardous due to their ability to cause certain health related disorders and even cancer. Exposure to such compounds can occur through dietary factors, factors associated with lifestyle (tobacco, alcohol etc.) and even the fields of occupation (cotton industries, rubber, chemical industries, Bidi industry etc). Infact, it has been estimated that almost all health-related disorders

even cancers arise as a direct consequence of such industrial/environment exposure.

Bidi industry is one such industry which is loaded with the tobacco dust, making it as a dangerous occupation as this dust is composed of many hazardous chemicals and it is a thin South Asian cigarette made of 0.2-03 gm of tobacco flake wrapped in a tendu (*Diospyrox melanoxylon*) leaf and secured with colored thread at both ends. As it is a cheap form of tobacco consumption, it is extremely popular among the poor but it carries

greater health risks as it delivers more nicotine, carbon monoxide and tar than conventional cigarettes.^{1,2}

The Bidi industry in India is an age-old industry. Tobacco-related industry is a major commercial enterprise around the world. Over the years, production and consumption of tobacco products has alarmingly increase throughout the world. In India, more than five million individual are involved in the production of bidi (a raw form of cigarette). Rolling bidi, an indigenous, handmade cigarette, has provided employment for millions of Indians (Mehra-kerpelman). These individuals work in small factories or at household-based enterprises in an environment laden with tobacco dust. A large part of this industry is unregulated, home based and is dominated by women who are usually involved in the process of rolling of raw bidis. Bidi rolling is a major occupation for a lot of women, who form the root the industry. Srinivasulu reported that 90% of bidi workers are women. Since they do not make use of any protective wear they get exposed to unburnt tobacco mainly through the cutaneous and nasopharyngeal route and nicotine was detected in urine and saliva indicating that there is absorption of substantial level of nicotine. Occupational health studies in this sector initiated as early as seventies amongst tobacco workers, showed an elevated level of nicotine in the urine samples (Ghose et al.). Individuals or bidi rollers working 6 to 10hrs/day, handle 125-450gm of tobacco. These individuals inhale, swallow and expose their skin and mucous surface to significant amount of particulate tobacco.^{2,4} Some of the study shows that, these workers are exposed to approximately 1.31 mg/m³ of tobacco dust.

According to Bagwe and Bhisey and Swami et al. tobacco bidi rollers are exposed to unburnt tobacco dust, mainly through the cutaneous and nasopharyngeal routes. The constituents of tobacco get absorbed into the body, get bio-activated and result in increased risk of developing ailments for which tobacco consumption is a major risk factor, including chronic obstructive pulmonary disease, cardiovascular system abnormality, carcinomas and premature death exposure among bidi-workers.^{3,5,6}

Tobacco particulate air pollution is one of the important problems in tobacco processing industries. Epidemiological studies showed that individual exposure to this type of air pollutant causes some adverse health effects especially respiratory outcomes such as asthma, chronic obstructive bronchitis and allergic respiratory or nasal diseases in workers exposed to tobacco dust.^{7,8} The present study was undertaken to evaluate the effects of exposure of the tobacco dust on status of Total Thiol in the bidi industry workers.

METHODS

The present study was done in Dr. V. M. Govt. Medical college, Solapur district, Maharashtra, India, in the

Tertiary Health Care Hospital (both OPD and IPD patients) were included in this study subjects.

Selection and Distribution of Subjects (Table 1). Control Group- Healthy Controls - 30 subjects. Normal healthy age matched female subjects (not exposed to any occupational dust) were selected as controls. The study group of 90 Bidi workers were further subdivided on the basis of exposure period (i.e. work experience in years) as.

Table 1: Distribution of healthy controls and study group subjects.

Groups	Bidi workers exposed to tobacco dust with work experience	No of subjects
Controls	--	30
Bidi workers		
Group-I	5-9 years	30
Group-II	10-14 years	30
Group-III	15-19 years	30

Inclusive criteria

The female bidi rollers within the age group of 15-60 years were selected.

Exclusive criteria

The subject having history of smoking, passive smoking and diseases such as Diabetes Mellitus, Renal Diseases, Cardiovascular Diseases etc. were excluded from study.

Collection of samples

After obtaining prior consent, venous blood was collected from the subjects under aseptic condition by venipuncture using 10ml sterile disposable syringe and needle. About 3-4 ml of blood was collected in a sterile plain bulb and was allowed to clot, then serum was separated and biochemical parameters Total Thiol Concentration estimated by Ellman and Hu method and Thiobarbituric Acid Reactive Substances estimated by Kei Satoh method.⁹⁻¹¹

Statistical analysis

Statistical analysis was done by using student 't' test and the data were expressed as mean±standard deviation (SD). Probability values of p <0.05 were considered to be statistically significant.

RESULTS

Highly significant decrease in levels of Total Thiol was found in both groups I, II and III of bidi workers as compared to healthy controls group (p<0.001) (Table 2). The present study indicates that serum Thiobarbituric

Acid Reactive Substances (TBARs) levels were significantly elevated in both groups I, II and III of bidi

workers as compared with healthy controls (p<0.001) (Table 3).

Table 2: Levels of total thiol in healthy controls and in different groups of bidi workers.

Groups	No. of subjects	Total thiol (mmol/L)	t value	p value		
Healthy controls	30	0.55±0.032	--	--		
Bidi workers						
Group-I	30	0.50±0.079	3.53	p<0.01		
Group-II	30	0.31±0.029	35.85	p<0.001		
Group-III	30	0.27±0.012	47.68	p<0.001		
Statistical group comparison						
Parameter	Gr-I with Gr-II		Gr-II with Gr-III		Gr-I with Gr-III	
Total thiol (mmol/L)	t=12.15	p<0.01	t=6.86	p<0.01	t=15.50	p<0.01

Values expressed in Mean±SD; p<0.05 = Significant, p<0.001= Highly Significant, p>0.05 = Non-Significant (N.S.)

Table 3: Levels of thiobarbituric acid reactive substances in healthy controls and in different groups of bidi workers.

Groups	No. of subjects	Thiobarbituric acid reactive substances (nmol/ml)	t value	p value		
Healthy controls	30	1.95±0.46	--	--		
Bidi workers						
Group-I	30	2.84±0.75	5.44	p<0.001		
Group-II	30	3.71±0.41	15.38	p<0.001		
Group-III	30	3.86±0.33	18.16	p<0.001		
Statistical group comparison						
Parameter	Gr-I with Gr-II		Gr-II with Gr-III		Gr-I with Gr-III	
Thiobarbituric acid reactive substances (nmol/ml)	t=5.41	p<0.01	t=1.53	p>0.05	t=6.70	p<0.01

Values expressed in Mean±SD; p<0.05 = Significant, p<0.001= Highly Significant, p>0.05 = Non-Significant (N.S.)

The serum levels of Thiobarbituric Acid Reactive Substances (TBARs) (in terms of Malondialdehyde, MDA)/lipid peroxide exhibited increase with the increasing exposure to tobacco dust.

DISCUSSION

Thiobarbituric acid reactive substances

The present study reveals that serum Lipid Peroxide / Thiobarbituric Acid Reactive Substances (TBARs) were significantly elevated in both groups I, II and III of bidi workers (highest increase in TBARs in group-III bidi workers) as compared with control subjects (p<0.001) (Table 3).

Suryakar AN et al, Swami S et al, also stated highly significant increase in serum lipid peroxides in different groups of female bidi industry workers as compared to healthy controls.^{12,13}

In experimental condition nicotine is found to be responsible for increase in levels of catecholamines.

These catecholamines might be undergoing auto-oxidation to produce free radicals which ultimately leads to increased lipid peroxidation in bidi workers.¹³

The oxidative burden of respiratory epithelium includes oxidants imaging on the apical (air) surface, inhaled ambient air and inflammatory cells on the epithelial surface generate free radicals. When macrophages and neutrophils ingest foreign particles (dusts), they undergo “respiratory burst” mediated by reduced nicotinamide adenine dinucleotide phosphate oxidase system.

Consequently, oxidants including superoxide anions and hydroxyl radicals are released into phagolysosome exposing ingested material to a high concentration of these free radicals. Thus, occupational dusts (tobacco dust) induce increased production of free radicals from neutrophils and macrophages leading to increased lipid peroxidation.^{14,15}

According to Bagwe AN, Bhisey RA and Mahimkar MB, Bidi workers exposed to a wide spectrum of tobacco-derived mutagens mediated mainly via hydroxyl radicals

may cause frame shift, base pair substitution and oxidative damage and also free radicals derived from nicotine ingredient of tobacco produce increased DNA damage with upsurge genotoxicity.^{16,17}

Total thiol

In the present study, highly significant decrease in levels of total thiol was found in different groups of bidi workers as compared to healthy controls ($p < 0.001$) (Table 2). which indicates that the utilization of total thiol is decreased to cope up with increased formation of Reactive Oxygen Species (ROS) / Free radicals. Which substantiates decrease total body thiols and it gradually progresses with increase in exposure period to tobacco dust.

No comparative data regarding quantitation of total thiol was available among bidi workers.

Thiols are the organic compounds that contain a sulfhydryl group. Among all the antioxidants that are available in the body, thiols constitute major portion of the total body antioxidants and play a significant role in defense against Reactive Oxygen Species (ROS). Thiol (SH) groups are essential in the protection against the deleterious effects of ROS. During detoxication of lipid peroxidation products, such as lipid hydroperoxides, aldehydes, and H_2O_2 , extensive glutathione (GSH) is consumed and this extensive GSH-consumption imperils the function of proteins that depend on a critical sulfhydryl moiety. Oxidation of these proteins may occur, resulting for instance in the dysfunction of Ca^{2+} -ATPases.¹⁸ Oxidative stress induces thiol and Nicotinamide Adenine Dinucleotide (NAD) depletion. The mechanism responsible for the fall in intracellular NAD levels is probably poly (ADP-ribose) polymerase, which uses NAD as substrate. This enzyme is activated under conditions of DNA strand breakage, which may occur in cells exposed to oxidative stress.¹⁹

In addition to dysfunction of Ca^{2+} -ATPase, clustering of lipid hydroperoxides and formation of lysophospholipids may result in calcium overload. An increase in intracellular Ca^{2+} levels leads to activation of Ca^{2+} -dependent enzymes such as proteases and phospholipase that lead to worsening of oxidative damage.²⁰ Oxidized species arises leads to the formation of protein thiolates which can be readily oxidized to a sulphenic acid that quickly form a disulphide with nearby thiol, strong oxidants will oxidize sulphenic or sulphonic acid derivatives.²¹ Oxidative stress thus, oxidize thiols of various proteins, this irreversible modification under biological relevant condition associated with oxidative injury lowers thiol levels.²²

Exposure to active oxygen reactive species in aerobic organism including human, is continuous and unavoidable. In fact, oxidation-reduction mechanism, have been widely adapted to function in and regulate

cellular process. But various factors disturb this prooxidant-antioxidant balance in favour of prooxidant leading to oxidative stress. From the above discussion it is clear that bidi workers due to exposure to tobacco dust are more prone to develop oxidative stress and this induced oxidative stress leads to many diseases related or accelerate the disease process.

CONCLUSION

The present study subjects showed that effects of exposure of tobacco dust on status of TBARs and Total Thiol in the bidi industry workers. As duration of exposure of tobacco dust increased, the effect was enhanced. This could be a cause of many diseases associated among bidi industries workers including genotoxicity and respiratory illness.

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