

Health Status of Textile Industry Workers: Prevalence and Socioeconomic Correlates of Different Health Problems

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Abstract

Thousands of workers are employed in textile industries under different job categories including dyeing, printing, finishing, cutting, weaving and spinning. The textile industry workers are exposed to a number of chemicals including dyes, solvents, optical brighteners, finishing agents and numerous types of natural and synthetic fibre dusts which affect their health. In this paper an attempt has been made to summarize the self-reported health problems among a group of textile industry workers. The current study was carried out in two textile based industries in Ludhiana city, Punjab, India. To assess the health problems prevailing among the workers, two questionnaires were developed. First questionnaire comprised of questions related to their demography and dietary habits. Second questionnaire was about the prevalence of different health problems among them. Data was subjected to statistical analyses for confounders. Textile industry workers were found to have an elevated risk to develop various health related problems including cough, cold, depression, headaches, sleep disturbances and skin allergies. Different health problems were also found to be positively correlated with duration of exposure, smoking, alcohol drinking, tobacco chewing and dietary pattern. The study showed that the textile industry workers exposed to dyes, solvents and fibre dusts are more prone to different health related problems. Textile workers should change their working methods and use proper protection equipments to minimize exposure to different chemicals.

Keywords

Textile Industry Workers, Health Problems, Cough, Skin Allergies

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1. Introduction

India is one of the leading countries in the sector of textiles and garments. In the export sector, India has overtaken many countries and has become second largest exporter in the field of textiles in the world. Textile industry has made remarkable contribution towards building national economy. It is also the second largest employment generation sector in India. This sector also attracts a huge investment from all over the world. Textile sector in India is in a strong position and is ready for more growth in the coming years both in domestic consumption as well as exports.

Textile industry in India can be divided into several segments namely cotton textiles, woollen textiles, silk textiles, readymade garments, jute, coir and hand crafted textiles [1]. All these segments need technical staff as well as daily wagers. Thus, textile industries employ lakhs of workers annually to meet their requirements. Some of the products in textile industries may include cotton yarn, blended yarn, organic cotton, modal yarn, vortex yarn, viscose yarn, acrylic yarn and acrylic-cotton yarn [1]. Making of all these products involve different degrees of exposures to different sets of substances including chemicals, dyes and solvents. Workers engaged in finishing processes are frequently exposed to crease-resistance agents. These agents may release

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formaldehyde which is known for its toxicity. These workers are also exposed to flame retardants including organophosphorus and organobromine compounds and antimicrobial agents. The textile industries use different kinds of dyes including the most commonly used azo dyes which are aromatic hydrocarbon derivatives of benzene, toluene, naphthalene, phenol and aniline [2]. The solvents used by the workers in different sections result in a major carcinogenic effect by direct contact with the subjects. Newhouse *et al.* [3] found higher mortality rates among workers engaged in bleaching and dyeing processes. Chronic occupational exposure to printing dyes and thinners may lead to a slightly increased risk of genetic damage [4]. The workers of the cutting and spinning section who work in closed environments with negligible exhaust conditions are highly exposed to fibre dust. The bad effect of fibre dust has previously been assessed by various researchers [5, 6]. Thus, in textile industrial sector, the workers are having multiple exposures to different sets of chemicals and fibres. This study was conducted to collect the health related data of textile industry workers of different sectors.

2. Material and Methods

2.1. Subject Selection

To conduct this study, a group of forty textile industry workers engaged in dyeing, printing, bleaching and spinning sections were selected from two textile based industries in district Ludhiana, Punjab. Both the factories were more than fifty years old. All the workers except 8 (20%) were immigrants from Bihar and Bengal who were working in the industry for several years. The textile industries selected for this study were running on full time basis without any seasonal gap and the workers were recruited on a full time basis for whole of the year. The part-time workers were excluded from the study. The workers frequently shifting in-between different types of industries were also ignored.

2.2. Questionnaire Survey

A questionnaire designed for this study was administered to the chosen textile industry workers (N = 40). The first questionnaire included questions based on dietary and smoking habits, alcohol intake, tobacco chewing and fruit intake. These parameters allowed to categorize the workers on the basis of different habits and to find out correlation among different parameters with different health related problems. An attempt was made to record a complete occupational history of each worker.

2.3. Health Related Questionnaire

A second questionnaire related to the health related problems

among textile industry workers was formulated as per the reported problems. Questions about loss of appetite, skin allergies, respiratory ailments (including cough and asthmatic condition), headaches, depression, sleep disturbances, weakness, hypertension and other ailments were designed. When the questions were asked, due care was taken to avoid suggesting the associations of these ailments with the place and nature of the job to the workers. They were interviewed out of the premises of their workplace. Thus the workers responded with an independent mind without any psychological association of their health related problems with their occupation.

2.4. Questionnaire Administration

The textile industry workers were interviewed in a park very close to their workplace to avoid any psychological relation of their answers towards their occupation. They were questioned during their normal working hours. Every worker was given a code number before the interview. The interview lasted 10-15 minutes.

3. Results

3.1. Characteristics of Textile Industry Workers

A group of forty textile industry workers engaged in dyeing, bleaching and spinning sections were selected for the present study and were questioned for their health related problems. Mean duration of exposure for 40 workers came out to be 6.2 ± 0.8 years with a range of 1-20 years (Figure 1). Some of the workers who participated were from the second generation but were having low duration of exposures. The workers had a varied economic status (Figure 2) with a salary range of Rs. 4500-18000 (Mean \pm SE; 7500 ± 476). According to the dietary habits, 22 workers were found to be non-vegetarians whereas 18 were vegetarians.

Table 1. Characteristics of textile industry workers (N = 40).

Character	Subject group	N	Percentage
Diet	Vegetarians	18	45%
	Non- vegetarians	22	55%
Alcohol drinking	Drinkers	11	27.5%
	Non-drinkers	29	72.5%
Smoking	Smokers	12	30%
	Non-smokers	28	70%
Tobacco chewing	Chewers	08	20%
	Non-chewers	32	80%
	Adequate	10	25%
Fruit intake	Moderate	27	67.5%
	Inadequate	03	7.5%

Workers were categorized into three different categories based on their habits of smoking, alcohol intake and tobacco use. The workers who used to smoke even a single beedi or

cigarette per day were considered as smokers. Workers taking minimum of 30ml alcohol per day were considered as drinkers. Under this criteria, 12 subjects (30%) were found out to be smokers and 28 (70%) were categorized as non-smokers whereas 11 (27.5%) were drinkers and 29 (72.5%) were found to be non-drinkers. In case of tobacco chewing, 8 workers (20%) were identified as tobacco chewers whereas 32 workers (80%) were not using tobacco in any form (Table 1, Figure 3). Only 25% (N = 10) workers were found to be taking fruits in an adequate amount required by a normal human body whereas 67.5% (N = 27) workers were found to be taking fruits in a moderate amount. 7.5% workers were found to be taking fruits in a very less amount (N = 3).

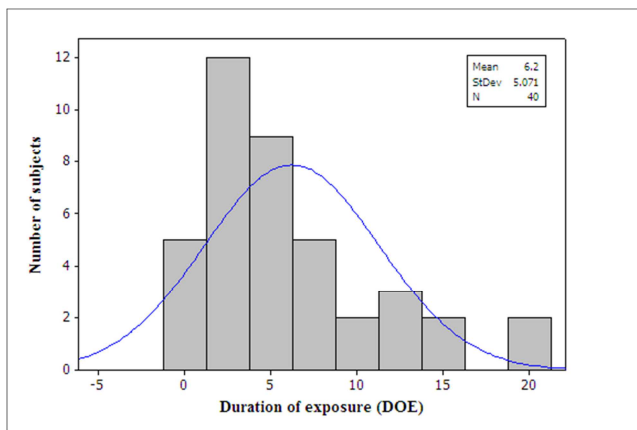


Figure 1. Frequency of duration of exposure among textile industry workers.

Table 2. Overall responses for different health problems (N = 17) among different groups of textile industry workers with respect to different habits.

Character	Group	N	Overall responses	Percentage
Diet	Vegetarians	18	58	39.18%
	Non-vegetarians	22	90	60.81%
Alcohol drinking	Drinkers	11	34	22.97%
	Non-drinkers	29	114	77.02%
Smoking	Smokers	12	40	27.02%
	Non-smokers	28	108	72.97%
Tobacco chewing	Chewers	08	32	21.62%
	Non-chewers	32	116	78.37%
	Adequate	10	37	25.00%
Fruit intake	Moderate	27	18	12.16%
	Inadequate	03	93	62.83%

3.2. Health Related Problems

In the present study a group of 40 workers was questioned for their health related problems. Table 2 shows the overall response of the workers to all the 17 health related problems. A total of 148 positive responses were recorded from the group, out of which 58 and 90 responses for different health problems were from workers on the basis of dietary habits viz. vegetarians and non-vegetarians. Whereas 34 and 114

responses were from drinker and non-drinker groups. 40 and 108 overall responses were recorded for smokers and non-smokers. 32 positive responses were given by tobacco chewers whereas 116 positive responses were by workers who were not using tobacco.

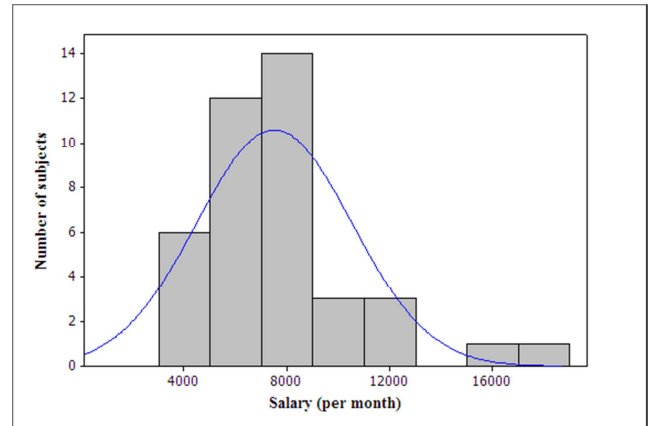


Figure 2. Frequency of salary per month among textile industry workers.

Similarly 37, 18 and 93 positive responses were recorded for adequate, moderate and inadequate fruit intaking groups respectively. There can be a direct relation of economic status (salary per month) with diet intake. A good diet can include more nutritious items and fruits which are rich in antioxidants. For this reason correlation between salary and fruit intake was found. Pearson correlation value for this test came out to be $R = 0.039$ ($p = 0.812$). Thus no such expected relation between economic status and fruit intake was found. However a significant correlation between duration of exposure (DOE) and economic status (Salary per month) was found ($R = 0.345$; $p = 0.029$). Figure 4 shows the correlation between DOE and salary as the peaks keep on increasing towards the salary as the duration of working increases in the industry. Average responses were calculated for the number of subjects in each category made with respect to duration of exposure (Figure 5). Exposure group of 11-15 years was found to have maximum average response for all the assessed health related problems whereas the exposure group of 6-10 years was found to have the minimum average responses (Figure 5).

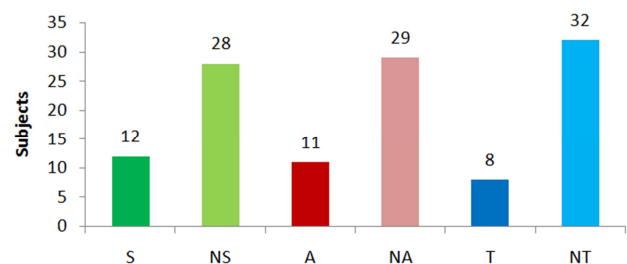


Figure 3. Categorization of textile industry workers with respect to smoking, drinking and chewing habits. S, Smoker; NS, Non-smoker; A, Drinker; NA, Non-drinker; T, Tobacco chewer; NT, Non-chewer.

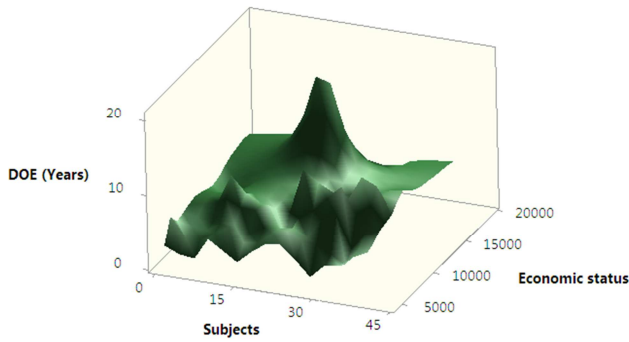


Figure 4. Surface plot showing the relation of salary per month (in rupees) with duration of working in the industry (experience). [$R = 0.345$; $p = 0.029$].

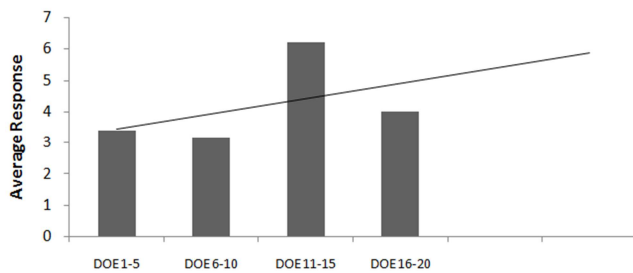


Figure 5. Overall average response for all the 17 health parameters assessed with respect to different exposure groups. Linear forecast trendline shows the increasing trend over the next two exposure groups.

The most frequent health problem among workers came out to be headache (27 responses out of 40). The second most prevalent problem was found out to be cough (19 responses).

Table 3. Correlation between factors and health related problems (Pearson Correlation, R values).

Factors	DOE	Alcohol	Tobacco	Smoking	Diet	Fruit intake
HA	-0.260	-0.170	0.214	-0.128	0.016	-0.170
MD	-0.428*	-0.219	0.050	-0.044	0.212	-0.107
DP	-0.407*	-0.219	0.050	-0.154	0.111	-0.199
AS	0.588*	0.420*	0.000	0.378*	0.174	0.133
WK	-0.155	-0.361*	-0.000	-0.056	0.182	0.131
HBP	0.113	0.158	-0.066	-0.158	-0.245	0.094
DB	0.000	0.000	0.000	0.000	0.000	0.000
NS	0.000	0.000	0.000	0.000	0.000	0.000
SP	-0.199	-0.102	0.315*	-0.275	0.099	-0.135
EI	0.181	-0.063	0.000	0.247	-0.114	0.017
FT	0.000	0.000	0.000	0.000	0.000	0.000
WL	0.197	0.037	-0.142	0.228	0.067	0.258
LA	0.000	0.000	0.000	0.000	0.000	0.000
CG	-0.283	0.087	0.150	-0.186	-0.045	-0.215
SD	-0.345*	-0.130	0.129	-0.169	0.078	-0.250
ML	0.045	-0.205	-0.167	-0.036	0.302*	-0.108
AM	-0.135	-0.141	-0.115	-0.150	0.208	-0.074

* $p < 0.05$; HA, Headache; MD, Dryness of mouth; DP, Depression; AS, Asthma; WK, Weakness; HBP, High blood pressure, Hypertension; DB, Diabetes; NS, Nausea; SP, Skin problems; EI, Eye irritations; FT, Fatigue; WL, Weight loss; LA, Loss of appetite; CG, Cough; SD, Sleep disturbances; ML, Memory loss; AM, Anemia.

4. Discussion

Textile industry is one of the leading economic sectors in India. Textile sector has generated millions of job opportunities all over the world. In Punjab, thousands of workers are employed in textile industries every year.

Then came depression during the working hours (18 responses). With 18 responses, dryness of mouth stood parallel to depression as per the score counts. All the health related problems with their response frequency has been given in the figure 6.

There were several health related problems including loss of appetite (LA), fatigue (FT), nausea (NS) and diabetes (DB) which scored a zero in the questionnaire round (zero responses). All the health problems were found for their individual correlation with confounding factors including DOE, alcohol drinking, tobacco chewing, smoking, non-vegetarian diet and fruit intake (Table 3). Dryness of mouth (MD), depression (DP), asthma (AS) and sleep disturbances (SD) were found to have a positive correlation with duration of exposure ($p = 0.006, 0.009, 0.000$ and 0.029 respectively). Similarly, asthma (AS) and weakness (WK) were found to be positively correlated with alcohol intake ($p = 0.007$ and 0.022). Skin problems were found to be associated with tobacco chewing ($R = 0.315$; $p = 0.048$). A significant positive correlation was found between asthma (AS) and smoking ($R = 0.378$; $p = 0.016$). Memory loss has been found to be correlated with the diet pattern ($R = 0.302$) but the correlation failed to reach statistical significance ($p = 0.059$).

Besides pushing the industries to new heights, the workers are contributing a lot in the overall growth of this sector at national level. But, these workers are exposed to a number of chemicals including dyes, solvents and finishers. Many of the researchers have studied the workers of cotton industry [7-20] regarding the respiratory health related problems and found

high prevalence of cough and colds among workers of cotton industry. As these workers are exposed to a high amount of fibre dusts of different nature depending upon the type of fibre used, they suffer from various respiratory ailments. In the present study 19 workers were found to be suffering from frequent cough throughout the year. 10 cases were recorded for the condition of asthma. The fibre dust may contain fibres of different lengths which have different health implications.

Textile fibre dusts are known for their health effects including cancer. Factors that can alter the biological activity of fibres are fibre dimensions, chemical composition and their surface properties. The clearance of fibres in the lungs depends upon the length of fibres. Fibres longer than $8\mu\text{m}$ are trapped at the mesothelial lining [21]. Thus long fibres, regardless of their composition, are more effective in producing mesotheliomas than shorter fibres [22]. The presence of Mg^{2+} ions on the fibres is an important factor in producing cytotoxic and carcinogenic effects [23]. The chemicals used in textile industry and fibre dusts are also known for producing oxidative stress among textile industry workers. Oxidative stress is the imbalance between reactive oxygen species (ROS) and the ability of the biological system to detoxify these reactive moieties [24]. Fe^{2+} and Fe^{3+} content in the fibres can catalyze Fenton reactions, generating a huge number of reactive oxygen species which are potentially mutagenic [25, 26]. Asbestos fibres have been shown to generate both reactive oxygen and nitrogen reactive species (ROS/RNS) causing oxidation and nitrosylation of DNA [27].

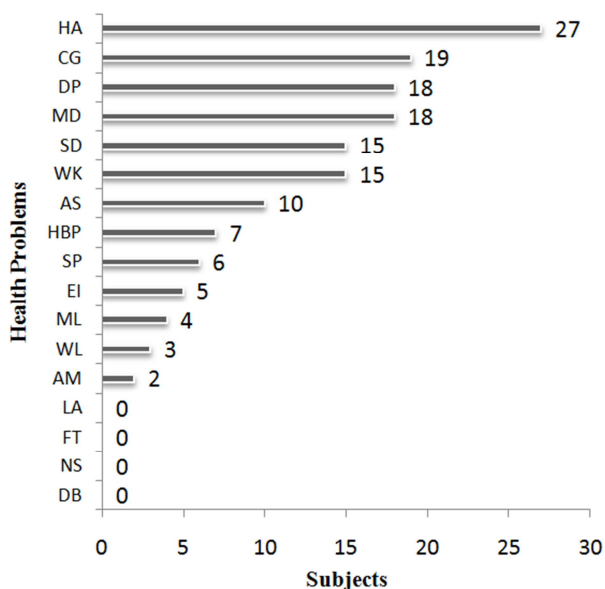


Figure 6. Frequency of different health related problems among textile industry workers (N = 40). HA, Headache; CG, Cough; DP, Depression; MD, Dryness of mouth; SD, Sleep disturbances; WK, Weakness; AS, Asthma; HBP, High blood pressure, Hypertension; SP, Skin problems; EI, Eye irritations; ML, Memory loss; WL, Weight loss; AM, Anemia; LA, Loss of appetite, FT, Fatigue; NS, Nausea; DB, Diabetes.

As the experience of the worker in the textile industry increases, he is given more sophisticated and technical work. It has been seen that salary of the worker is increased with experience. According to the questionnaire, it was found that the reported salaries were significantly increased according to their experience. Figure 4 shows the correlation of salary per month with the duration of exposure or experience. It is believed that with increasing salary, one can enrich his diet by taking more fruits. As fruits are rich in antioxidants, these may help in overcoming the effects of different chemicals to which the workers are exposed while working. But there was a non-significant correlation found between salary per month and fruit intake ($R = 0.039$; $p = 0.812$). Thus fruit intake by the workers was not found to be affected by their salaries.

The use of dyes and solvents in the textile industry are the main toxic substances used. Different types of dyes used in the textile industries pose a toxic effect [28-32]. Many of the researchers have used different test dyes used in textile industries to evaluate their toxicity [33-41]. Different models have also been used including fish [42, 43], frog [44], pottery painters [45], *Drosophila* [46] and *Daphnia* [47]. As textile industry workers in the present study were exposed to different dyes and solvents, effect of exposure was assessed on the self-reported health related problems among textile workers. Workers (N = 40) were divided into four groups with respect to the duration of exposure viz. 1-5 years, 6-10 years, 11-15 years and 16-20 years. Maximum workers fall into the first exposure group of 1-5 years (N = 20). Rest of the groups were having 13, 05 and 03 workers respectively. A total of 148 positive responses were recorded on administration of the questionnaire among these four exposure groups with 68, 41, 31 and 08 responses per group respectively. Overall average response was found for each exposure group. Maximum average response was found to be highest in the group of 11-15 years. The minimum was found to be in the exposure group 6-10 years. It was found that dirty and tedious work was given to the newly joined workers in the industry. Thus the first exposure group (1-5 years) was having higher average responses for health related problems. Highly experienced workers (exposure group 16-20 years) were given administrative jobs, thus having less chemical and fibre exposure. Their average response was found to be less than expected. Figure 5 shows the increasing average response among four exposure groups. Linear forecast trendline predicts the increasing trend upto the next two exposure group levels.

Correlations for self-reported 17 health related problems were found with different confounding factors including duration of exposure, alcohol intake, tobacco chewing, smoking, non-vegetarian diet and fruit intake. Out of all the factors, duration of exposure (DOE) was found in positive

correlation with a maximum of four health related problems. Dryness of mouth (MD), depression (DP), asthma (AS) and sleep disturbances (SD) were found to have a positive correlation with duration of exposure ($p = 0.006, 0.009, 0.000$ and 0.029 respectively). Two health problems (asthma and weakness) were found to be associated with alcohol intake. Skin problems, asthma and memory loss were found to be associated with tobacco chewing, smoking and diet respectively. Skin problems have also been previously reported in cotton industry [18, 19]. Rest of the problems reported by the workers were not found to be associated with any of the 6 factors, thus are predicted to be due to the exposure of the workers to different sets of chemicals and fibres only. Thus occupational exposures to dyes, solvents, finishing and bleaching agents, and fibre dusts are harmful for the workers engaged in the textile industries. The workers should improve their working methods or they should use proper protection equipments for decreasing the magnitude of their exposure to the chemicals being used.

5. Conclusion

Thousands of workers are employed annually in the textile sector to meet the demands of country. But the workers engaged in different sections of the textile industry are exposed to different sets of known and unknown compounds produced as a result of different industrial processes which are responsible for various health related problems in textile industry workers. The present study confirmed that textile industry workers are more prone to develop different health related ailments due their occupational environments. Conclusively, textile industry workers must change their work-style and should use proper protection equipments to minimize the effect of the chemicals being used in the textile industry.

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