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Analysis of the Occurrence of Respiratory Disorders in Workers in the Sri Lankan Apparel Industry

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Abstract

The main objective of the study was to assess if there is a correlation between respiratory diseases and exposure to cotton, hemp and other dust particles in the Sri Lankan apparel industry. Designed research employed in this study was a cross-sectional study. Population consisted of all apparel workers in the Sri Lankan apparel industry, whilst the sample was made up of 384 workers from three participating factories. The method data collection instrument used in the study was a structured self-administered questionnaire and personal air sampling device. Findings from the study revealed that one out of every five participants has experienced respiratory problems over the last twelve months. In addition, findings also indicate that exposure to cotton, hemp and other dusts particles has a correlation with respiratory problems of apparel workers in Sri Lanka.

Keywords: Respiratory disorders; Apparel workers; Sri lanka; Retail companies

Introduction

The Sri Lankan apparel industry is the primary foreign exchange generating industry in the country ($ 400 Million (BOI, 2017)). Total exports of the industry in 2016 were $ 4.2 billion, which was approximately 40% of the country's total exports (ibid). In addition, the industry contributed approximately 6% to the country's gross domestic product, 30% to the country's industrial production, 33% to the country's manufacturing employment (approximately 283,00 direct and indirect jobs), and 67% to the country's industrial exports (ibid) in 2016. Apparel manufacturing is the primary business activity of Sri Lankan. Companies in the industry manufacture garments for a wide range of global clothing and retail marketing such as Victoria Secrets, Nike, Pierre Cardin, Gap, etc., (ibid). The main aim of this study was to evaluate the respiratory disorders and diseases amongst Sri Lanka apparel workers on account of high exposure to dusts particles such flax, hemp and cotton dusts, and analyse the socioeconomic consequences faced by workers affected by these diseases and disorders.

Respiratory effects and disorders such as byssinosis on account of exposure to hemp, cotton, flax and other types of dust are extremely high in the apparel industry. Numerous research relating to the effects of hemp, cotton, flax, and other types of dusts particles on workers in the apparel industry, indicates that this exposure has a significantly impact on the health of these workers. Research conducted by the United States National Heart Lung and Blood Institute (2007) in this regard found that exposure to these dust particles resulted in airflow hypertension and reversible airflow obstruction in apparel industry workers. Research on Grade I and II stages of Byssinosis, identified a significant increase in chronic obstructive lung diseases in apparel industry workers on account of the prolonged exposure to hemp, cotton and flax dust [1,2]. Studies conducted by Zuskin E, et al. [3] found a significant change in the levels of forced expiratory volume in one second (FEV_1) of apparel industry workers at beginning and end of a work shift on account of exposure to cotton and other dust particles, whilst other studies have identified a high correlation between exposure to these dust particles and nonspecific bronchial hyperactivity in apparel workers.

Although there is a clear empirical evidence that high exposure to cotton, flax, hemp and other dust particles are the primary causes of respiratory diseases like asthma and byssinosis amongst apparel workers, research said that the effect of dust exposure in the Sri Lankan apparel industry is limited. Prolonged exposures to these dust particles can result in disablement and in worst cases even death. In addition to the respiratory disorders there is a detrimental impact on the apparel workers and his family on account of the inability to work, high health related expenses, loss of income, loss of employment, etc. High respiratory disorders amongst apparel workers also impact the local apparel industry at its results in the loss of productivity due to worker absenteeism, worker attrition, etc. which in turn effects the competitiveness and viability of the industry.

Literature Review

Empirical Research on the Occupational Hazards Faced by Workers in the Global Apparel Industry

Nafees AA, et al. [4] in their study "Pattern and predicators for respiratory illnesses, symptoms and lung function among textile workers in Pakistan" attempt to determine the pattern and predicators for respiratory illnesses and symptoms and lung function among textile workers in Pakistan. This study consisted of a cross-section survey of adult male textile workers attached to the spinning and weaving departments of fifteen textile factories located in Karachi, Pakistan. Sample for the study consisted of 372 workers from these fifteen textile factories. Findings from this study revealed that byssinosis was present in 10.5 percent of the workers, chronic cough was present in 7.5 percent of the workers, chronic phlegm was present in 12.9 percent of the workers, wheeze accompanied by shortness of breath present in 22.3 percent of the workers, chest tightness was present in 33.3 percent of the workers, grade two shortness of breath was present in 21 percent of the workers, whilst low levels of asthma (4 percent) was also present in this population [4].

Jannet JV, et al. [5] in their study "Pulmonary health status of ginning factory women labourers in Tirupur, India" focused on analysing the pulmonary function of woman labourers employed in ginning factories in Tirupur, India. Sample for the study consisted of 104 female labourers. Assessment of the pulmonary function of these workers was conducted via spirometer and chest X-rays. Standard two tailed test (normal distribution) was employed to measure the significance of the chronic changes within the percentage predicted values of pulmonary function (ibid). In addition, multiple regression and correlation was also employed in this study was to assess the effected age and prolonged work in ginning factories has the pulmonary function of this population. Findings from the study revealed that byssinotic symptoms were present in 65.7 percent of

these workers; chronic bronchitis symptoms were present in 23.7 percent of these workers, whilst occupational asthmatic symptoms were present in the 10.53 percent of these workers. In addition, this study also found that the population also suffered from a number of none pulmonary function related diseases such as headaches, defective eyesight, body aches, hypertension, dental problems, and diabetes (ibid).

The main objective of Alemu K, et al. [6] in their study "byssinosis and other respiratory symptoms among factory workers in Akaki textile factory, Ethiopia" was to determine the prevalence of byssinosis amongst factory workers at Akaki textile factory, Ethiopia, and identify the factors causing byssinosis and other respiratory symptoms in these workers. The research method employed in this study was a cross-sectional study. Sample consisted of 417 randomly selected workers from Akaki textile factory. The main data collection instrument used in this study was modified American Thoracic Society Respiratory Symptoms questionnaire. In addition, portable medical spirometers were used in this study to measure forced expiratory volume in 1 sec (FEVI), forced vital capacity (FVC), and the ratios for both FCV and FEV1. Findings from this study indicated a high prevalence of respiratory issues in the carding department of the factory. Reported respiratory issues in workers in the carding department of the factory were 16 times higher than in other sections of the factory. More the three quarter of the workers in the carding sector (77 percent) revealed that they had persistent coughs, 62 percent reported phlegm symptoms, 46 percent reported tightness of chest symptoms, whilst 62 percent reported symptoms of Dyspnea. In addition, this study also found that reported chronic bronchitis cases in the carding department was 13 times higher than reported cases in the other departments of the factory. Further, the study also found high mean dust levels in the carding and blowing sections of the factory, which had resulted in workers in these two sections, been exposed to high dust levels.

Empirical Research on the Occupational Hazards Faced By Workers in Sri Lanka's Apparel Industry

De Silva PV, et al. [7] in their study "Health status and quality of life of female garment workers in Sri Lanka" investigated the health problems and quality of life of female apparel workers in Sri Lanka. The research method used in this study was a combination of qualitative and quantitative approaches which was used in two phases. In the first phase, focused group interviews were conducted with 24 randomly selected female garment factory workers to identify the common health problems faced by these workers. Findings from these focused group interviews indicated that respiratory problems, accidental injuries, musculoskeletal pains, headaches, and dermatological problems were the main health related issues faced by these workers. In second quantitative phase of this study, a cross-sectional survey was developed based on the findings from the focus group interviews. This cross-sectional survey consisted of two questionnaires. The first questionnaire in this second phase was an interviewer administered questionnaire. This interviewer administered questionnaire was used to obtain data on the demographic factors, verbal and sexual harassments, and the common physical and occupational health issues faced by female garment workers in Sri Lanka. Sample for the interviewer administered questionnaire survey consisted of 1,762 randomly selected female apparel workers from apparel factories located in the Koggala Free Trade Zone (FTZ) of Sri Lanka. Sample participants from each of the garment factories in this FTZ were selected using a stratified sampling technique. The second questionnaire in this cross-sectional survey consisted of a World Health Organization (WHO) quality of life questionnaire which was also administered to the same sample respondents from the first questionnaire. Findings from this study revealed that musculoskeletal pains was the most common health related issue of female garment factory workers (15.5 percent), followed by headaches (7.6 percent), workplace accidents (5.6 percent), and respiratory diseases (3.4 percent). In terms of musculoskeletal pains, the most common pains reported by female garment factory workers were back and knee pains. In terms of headaches, migraine and tension related headaches were the main headaches reported, whilst in terms of respiratory disorders, wheezing plus breathlessness was the main respiratory disorder reported, followed by tightness in the chest, and SOB attach at rest.

Tammita U, et al. [8] in their study "A study of employee absenteeism in the apparel industry" attempted to identify the significant factors for employee absenteeism in Sri Lanka's apparel industry. Sample for the study consisted of 150 apparel workers who were selected from ten apparel factories in the country. The main data collection instrument used in this study was a self-administered questionnaire, which consisted of 18 closed ended questions. This survey was conducted to ascertain the impact the 18 identified factors have on worker absenteeism in the industry. A likert scale with values from 1 (strongly disagree) to 5 (strongly agree) was used to obtain a controlled response from the questionnaire survey. Data obtained from the self-administered questionnaire was analysed using descriptive statistics such as mean, standard deviation, kurtosis, and skewedness. Findings from the study, indicated that of the eighteen factors identified i.e. job satisfaction, recognition of employee status, working conditions, performance driven employee targets, working hours, supervisor support, work load, work related illnesses, age, marital status, private life issues of workers, remuneration, organizational leave policy, opportunity to participate in decision making at the company, incentive scheme of the company, organizational policies and rules, and job fit, six factors namely supervisor support, work overload, age of worker, incentives, employee job fit, and salary have no impact on employee absenteeism, whilst all the other factors have an impact on employee absenteeism.

Lombardo SR, et al. [9] in her study "Musculoskeletal symptoms among female garment factory workers in Sri Lanka" assessed the types and extent of work related musculoskeletal health problems experienced by female garment factory workers in Sri Lanka. In addition, this study also attempted to identify the risk factors associated with higher rates of musculoskeletal diseases in female garment factory workers in Sri Lanka. The research methodology employed in this study was a cross-sectional study. Sample population for the study consisted of 1,058 female garment factory workers from garment factories located in the Koggala FTZ of Sri Lanka. The primary data collection instrument employed in the study was interviewer administered questionnaire. Findings from this study revealed that 15.5 percent of garment factory workers in Sri Lanka suffer from musculoskeletal symptoms which had occurred at least three times during the past year, with each occurrence lasting for more than a week. The main areas in the body in which workers experienced musculoskeletal pain was the back (57.3 percent), the knees (31.7 percent), shoulders (9.1 percent), hands and wrists (7.3 percent), neck (6.7 percent), and forearms and elbows (3.7 percent). This study also found that musculoskeletal health problems experienced by these workers had impacted their work quality, household chores, and leisure activities. Further, this study also found a positive correlation between age and occurrences of musculoskeletal health issues, and also positive correlations between tenure in the industry and musculoskeletal health issues, and low educational standards and musculoskeletal health issues.

Exposure to Cotton, Hemp and Flax Dust Effect on Textile and Garment Industry Workers

Dust is defined by the International Standardization Organization (ISO 4225 – ISO, 1994) as "small solid particles, conventionally taken as those particles below 75 µm in diameter, which settle out under their own weight, but which may remain suspended for some time", whilst according to the Glossary of Atmospheric Chemical Terms (IUPAC, 1990) it is defined as Small, dry, solid particles projected into the air by natural forces, such as wind, volcanic eruption, and by mechanical or man-made processes such as crushing, grinding, milling, drilling, demolition, shovelling, conveying, screening, bagging, and sweeping. Dust particles are usually in the size range from about 1 to 100 µm in diameter, and they settle slowly under the influence of gravity". Dust occurs under normal environmental conditions e.g. volcanic ash, dust storms, etc., as well as in the work environment. Common forms of dust which can be found in the work environment include mineral dust i.e. dust which contains free crystalline silica, cement, and goal dusts; metal dust i.e. metal, beryllium, nickel, and cadmium dusts; other types of chemical dusts i.e. dust generated from bulk pesticides and chemicals; organic and vegetable dusts such as cotton, flour, and tea dusts; and biohazards such as moulds, spores and viable particles (WHO, 1999). Cotton dust can be defined as "dust present in the air during the handling or processing of cotton, which may contain a mixture of many substances including ground up plant matter, fibre, bacteria, fungi, soil, pesticides, non-cotton plant matter and other contaminants which may have accumulated with the cotton during the growing, harvesting and subsequent processing or storage period. Any dust present during the handling and processing of cotton through the weaving or knitting of fabrics, and dust present in other operations or manufacturing processes using raw or waste cotton fibres and cotton fibre by-products from textile mills are considered cotton dust within this definition" [10]. Cotton dust can be classified into different types based on the size of cotton dust particles (Table 1).

Based on the extent to which breathable cotton dust is deposited into the respiratory system, it can be further divided into thoracic dust i.e. cotton dust which is hazardous when deposited within the lung airways and gas exchange region [10] (Fibre2Fabric.com, 2008), respirable dust i.e. fractions of dust which reach the alveolar regions of the lungs (ibid), and inhalable dust i.e. dust which is hazardous when deposited anywhere in the respiratory tree, this includes both the mouth and nose (ibid). In addition to inhalation, which is the most route of exposure to dust, other routes of dust exposure include skin absorption, ingestion, and effects on skin. Skin absorption occurs when "water-soluble materials dissolve in sweat and pass through the skin into the blood stream causing systemic intoxication" [11]. Ingestion of dusts occurs when poor hygienic conditions results in contamination of food and water in workplaces. Classic cases of exposure to ingestion include food poisoning on account of foods kept in small potteries being contaminated with lead salts. Ingestion of dusts in the workplace can be significantly reduced by ensuring excellent personal hygiene, safe and healthy procedures, and good housekeeping at the workplace. In addition to the absorption of dust through the skin, dust can also have a direct effect on the skin, resulting in dermatoses. As per the WHO dermatoses are widespread in the global work environment, and can result in serious health issues such as skin cancer [11]. Prolonged exposure to dust can result in numerous pulmonary and systemic healths related effects. Systemic health related effects on account of the prolonged exposure to dusts range from an increase in body temperature, to generalized malaise [12], whilst pulmonary health effects on account of this exposure range from asthma, to coughing, byssinosis, chronic bronchitis, emphysema, and phlegm [13].

Type of Cotton Dust	Size of Particles (Mm)
Trash	> 500µm
Dust	50 µm – 500 µm
Micro dust	15 µm – 50 µm
Breathable dust	< 15 µm

Table 1: Classification of cotton dust [9].

Research Methodology

Study Area

Selected study area was the Kandy district, in Sri Lanka's Central Province. Kandy is the capital city in Sri Lanka's Central Province and is home to over 100 garment factories. This study area was selected due to the presence of various types of garments factories ranging from large multinational garment factories, to medium size factories, and small family owned factories. In addition, the study area was also selected on account of its proximity to the researcher's residence. Proximity to the researcher's residence resulted in considerable savings of time and money in conducting the research.

Research Design

The research design employed in this study is mixed cross-sectional research design. This research study was conducted over a period of three months. The first section of this study consisted of a questionnaire survey which was administered to participants from three garments factories located in the study area. This survey was administered to identify the extent of byssinosis and other respiratory disease amongst participants. Subsequent to the survey, personal dusts samples were taken from each of the participating factories.

Description of participating factories; Factory A: Factory A is one of Sri Lanka's largest apparel manufacturers and is cited in the Pallekele, BOI administered zone, in the Central province, of the country. Factory A is a manufacturer and supplier of "intimate-wear". Factory A has an employee cadre of over 1,500 employees. Most employees are blue collar workers who are employed in the various manufacturing department of the company. 65 percent of the employees of the company are female employees, whilst the rest of the employees are male employees. Factory A has employed numerous strategies to protect its workers from high exposure to cotton, hemp, flax and other dust particles. These strategies range from the installation of dust extractors, to positive cold airflows. Further, the company has also provided protective clothing, face masks, and gloves to employees to mitigate industrial accidents in the plant. Most of these employee safety initiatives in Factory A have been driven by the need to comply with stringent customer requirements in this regard.

Factory B: Factory B which was incorporated in 1992 is a medium size apparel manufacturer in Sri Lanka. Factory B provides employment to 800 individual. Factory B manufacturers approximately 450,000 garment pieces monthly. Of the 800 individuals employed in Factory B, 68 percent are female employees, whilst the balance 32 percent of the employees are male. Factory B also employed a number of strategies to reduce worker exposure to cotton, hemp and other dust particles. These strategies include positive cold airflows and the providing of protective clothing to safety wear to employees. Similar to Factory A, the employee safety and health initiatives of Factory B is driven by the necessity to comply with compliance requirements of customers in this regard.

Factory C: Factory C which was established in 1997 is a medium size apparel manufacturer in Sri Lanka. Factory C which has

staff strength of approximately 500 employees produces 75,000 apparel pieces for a month which are exported to key customers in the Australia, Europe, and USA. The employee cadre of Factory C consists mostly of female employees who make up 70% of the company's workforce. Most employees of the company are located on factory floor and other manufacturing departments of the factory. The company has not established any initiatives to reduce worker exposure to cotton, hemp and other dust particles.

Sample

Population: Population for the study are all workers in Sri Lanka's apparel industry i.e. approximately 300,000 workers [14].

Sample: Sample size is 384 apparel workers. Note, sample size for the study was determined using a sample size calculator with a confidence level of 95% and a confidence interval of 5%. Sample was selected from the participating factories. Number of participants from each factory was determined using a stratified sampling method. Number of participants selected from each participating factory is shown in table 2. Sample participants from each participating factory were selected using a random sampling method.

Data Collection

A self-administered questionnaire survey was conducted to identify extent of respiratory disease and disorders amongst participants. The questionnaire consisted of 25 close-ended questions. The structure of questionnaire of this questionnaire is shown in table 3.

In terms of sampling of dust particles in the environment of the participating factories, whilst there are numerous dusts sampling methods which could be employed by the researcher in this regard (Table 4), the sampling method used in this study was a personal sampling instrument. This sampling method was selected as it enabled the researcher to measure the extent of dusts exposure of individual workers in the factory. The instrumentation used in this regard was a Personnel Sampling Pump (Gilair-3) with flexible connecting tubing, 37 mm cassette filter, and same size filter papers with pore size of 0.45 µm. Sampling pumps were attached to the workers in particular areas.

Factory	Number of Employees	Total %	Number of participants
Factory A	1,500	54%	207
Factory B	800	29%	112
Factory C	500	17%	65
Total	2,800	100%	384

Table 2: Selection of participants from participating factories.

Data Analysis

Data from the cross-sectional study will be analysed using simple statistical methods such as mean, median and standard deviation. Data obtained from the air checker sampler will be forwarded to Industrial Environmental Services (Pvt. Ltd. (a third party company), which specializes in analysing this type of data. Findings from the data analysis will be presented using simple figures and tables.

Data Analysis and Findings

Out of the sample size of 384, approximately 370 participants (96.3 percent of the sample) completed and returned the questionnaire. Our written questionnaires were rejected 15 questions due to incompleteness. This result in data from 92.45 percent (355 participants) of the sample been used in the study. The demographic profile of study sample is shown in table 5.

Respiratory Problems of Participants Not Associated With the Flu or Cold

The respiratory problems of participants over the last 12 months at times when the participant did not have a cold or the flu is shown in table 6. As shown in this table, total number of participants who had respiratory problems over the last 12 months which cannot be associated with a cold or the flue is 75 or 21 percent of the participants. Participants from Factory C had the most number of respiratory problems (52 cases), followed by Factory B (15 cases), and Factory A (8 cases). What is concerning in this table is that 89.66% of the participants from Factory C reported respiratory problems, whilst only 16.32% and 4% out of the total participants from Factory B and A respectively reported respiratory problems.

In terms of total number of days over the last 12 months in which participants have had these respiratory problems, table 7 shows the total number of days participant have been affected by these respiratory problems. As shown in this table, 38 of the 75 participants experienced these problems for between 1–5 days over the last 12 months, 22 of the participants experienced these problems between 6–10 days, and 15 of the participants experienced these problems for more than 10 days over the last 12 months. In terms of the factories, participants from Factory C were the highest in all three categories, followed by those in factory B, and Factory A.

The time period at which participants first experienced these respiratory problems is shown in table 8. As shown in this table, the time period at which participants first experienced these respiratory problems differs from factory to factory. Whilst a majority of participants from Factory A and B experienced these

Purpose	No. of Questions	Order of Questions
Develop a demographic profile of participant	10	1 to 10
Identify the various respiratory disorders and symptoms of participants (Note: these questions were taken from the International Commission on Occupational Health questionnaire respiratory symptoms section)	10	11 to 20
Understand the economic and social consequences to the participant on account of being affected by byssinosis or any other respiratory disorders	5	21 to 25

Table 3: Structure of self-administered questionnaire.

Method	Advantage	Disadvantage	Use
Direct reading instruments	Easy to use Provides an instant measurement	Lacks specificity, precision and sensitivity Does not provide information on personal exposure	Able to estimate environmental levels, Walk through surveys, Leak detection
Personal sampling methods	Provides personal exposure data Sensitive and selective	Does not provide instant measurement. Training required for the use of equipment, Measures employed are labour intensive	Measures personal exposure Risk assessment compliance monitoring

Table 4: Dusts sampling methods available to the researcher.

Variable	Frequency	Percentage
Gender		
Male	95	27
Female	260	73.24
Age		
< 20 Years	55	15
20 – 30 Years	117	33
30 – 40 Years	102	29
40 – 50 Years	61	17
> 50 Years	20	6
Marital Status		
Single	148	42
Married	195	55
Other	12	03
Educational Qualifications		
Up-to GCE O/L	75	21
GCE O/L	104	29
Up-to GCE A/L	87	25
GCE A/L	71	20
Other	18	5
Experience in Apparel Industry		
> 1 Year	45	13
1.1 – 5 Years	98	28
5.1 – 10 Years	79	22
10.1 – 15 Years	87	25
> 15 Years	46	12
Monthly Remuneration		
< LKR 20,000	111	31
LKR 20,001 – 30,000	87	25
LKR 30,001 – 40,000	75	21
LKR 40,001 – 50,000	45	13
> LKR 50,000	37	10
Current Employer		
Factory A	199	56
Factory B	98	28
Factory C	58	16
Number of participants who smoke		
1 Cigarette a day	5	1.4
2 – 5 Cigarettes a day	8	2.2
6 – 10 Cigarettes a day	6	1.7
11 – 15 Cigarettes a day	6	1.7
> 15 Cigarettes a day	18	5
Total	43	12

Table 5: Demographic Profile of Study Sample. (Source: Data from the study sample).

Respiratory Problem	Factory A	Factory B	Factory C	Total
Wheezing	3	5	12	20
Coughing	2	3	13	18
Chest tightness	1	3	11	15
Shortness of breath	2	4	16	22
Total	8	15	52	75

Table 6: Respiratory problems not associated with a cold or flu of participants over the last 12 months. (Source: Data from the study sample).

Number of days	Factory A	Factory B	Factory C	Total
1 – 5 days	5	8	25	38
6 – 10 days	2	4	16	22
> 10 days	1	3	11	15
Total	8	15	52	75

Table 7: Total number of days over the last 12 months participants has experienced these respiratory problems. (Source: Data from the study sample).

Months	Factory A	Factory B	Factory C	Total
< 6 months	0	0	29	29
6.1 – 12 months	1	2	17	20
12.1 – 18 months	1	4	1	6
18.1 – 24 months	2	5	4	11
> 24 months	4	4	1	9
Total	8	15	52	75

Table 8: Time period in which participants first experienced respiratory problems. (Source: Data from the study sample).

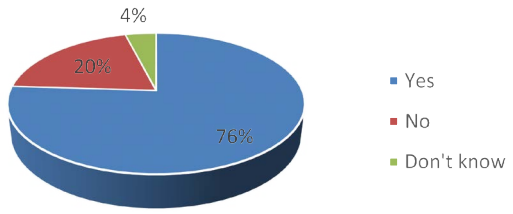

Figure 1: Number of participants who experienced these respiratory problems after joining the apparel industry. (Source: Data from the study sample).

	Factory A	Factory B	Factory C	Total
Yes	1	3	36	40
No	5	8	9	22
Don't know	2	4	7	13
Total	8	15	52	75

Table 9: Number of participants who first experienced respiratory problems after joining the current company. (Source: Data from the study sample).

problems more than 18 months ago, a majority of Factory C participants experienced these respiratory problems very recently i.e. over the last 1 to 12 months.

In terms of whether these respiratory problems were first experienced by participant after joining the apparel industry, figure 1 shows the number of participants who indicated that they first experienced these problems after joining the apparel industry. As shown in this figure, 57 participants (76 percent) out of the 75 participants who reported experiencing respiratory problems indicated that they first experienced these problems after joining the apparel industry.

Table 9 shows the number of participants who indicated that they first experienced these respiratory problems at the time of joining their current company. As shown in this table, a large number of participants from Factory C indicated that they first experienced these respiratory problems at the time of joining their current company.

Figure 2 shows the extent to which participants who reported experiencing respiratory problems are still affected by these problems. As shown in this figure, out of the 75 participants who experienced respiratory problems over the last 12 months, 59 participants (79 percent) indicated that they are still affected by these respiratory issues.

Figure 3 shows the extent to which the participants experience these respiratory problems when they are away from work i.e. during the weekends and holidays. As shown in this figure out of the 75 participants who reported having experienced respiratory problems

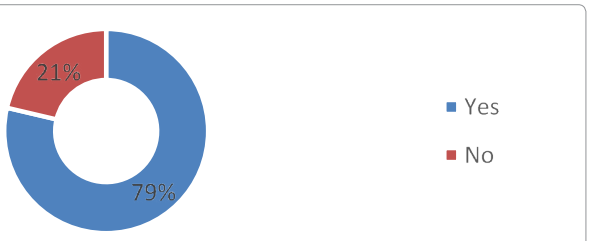

Figure 2: Participants who still have respiratory problems. Source: Data from the study sample.

Figure 3: Change in respiratory problems when away from work. (Source: Data from the study sample).

Figure 4: Change in respiratory problem on account of been away from the workplace. (Source: Data from the study sample).

Figure 5: Change in respiratory problems of participants at the beginning of the work week. (Source: Data from the study sample).

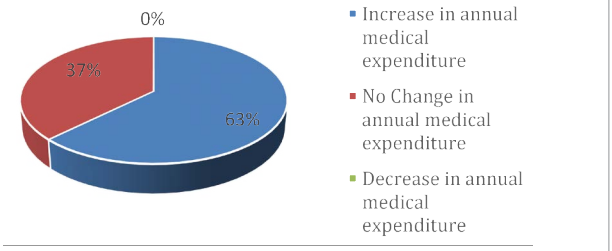

Figure 6: Respiratory problems impact on the annual medical expenditure of participants. (Source: Data from the study sample).

Figure 7: Respiratory problems impact on the financial position of participants. (Source: Data from the study sample).

over the last 12 months, a majority (84 percent) reported a change in their respiratory problems when away from the workplace.

In terms of the change being away from the workplace had on the respiratory problems of the participants, out of the 63 participants who indicated that been away from the workplace changes their respiratory problems, all indicated that been away from the workplace reduced their respiratory problems (Figure 4).

Figure 5 shows the number of participants who reported experiencing these respiratory problems at the start of the working week. As shown in this figure out of the 75 participants who reported experiencing respiratory problems over the last 12 months, 63 participants indicated a change in their respiratory problems at the beginning of the week.

In terms of the change in the respiratory problems at the beginning of the work week, all participants who indicated a change in their respiratory problems at the beginning of the week indicated that their respiratory problems worsen at the beginning of the week.

Impact of Respiratory Problems on the Socioeconomic Status of Participants

In this section the impact respiratory problems have on the socioeconomic status of the participants is shown. Figure 6 shows the impact respiratory problems has had on the annual medical expenditure of the participants. As shown in this figure, out of the 75 participants who reported experiencing respiratory problems over the last 12 months, 47 participants indicated that respiratory problems had resulted in an increase in their annual medical expenditure, whilst 28 participants indicated no changes in their annual medical expenditure on account of these respiratory problems. Figure 6 indicates the respiratory problems impact on the annual medical expenditure of participants. Figure 7 shows the impact on respiratory problems and their financial position of participants in terms of salary increments, performance bonuses, and attendance allowances. As shown in this figure of the 75 participants who experienced respiratory problems over the last 12 months, 92 percent indicated that these respiratory problems have had a negative impact on their financial position.

Table 10 shows the impact on respiratory disorders on career development, family, and social life of participants. As shown in this table, of the participants who indicated that they had experienced respiratory problems over the last 12 months, 84 percent indicated that these problems had impact their career development prospects, 89.3 percent indicated that these problems had impacted their family life, and 77.3 percent indicated that these problems had impacted their social life.

Dust Concentration in the Work Environments of the Participating Factories

This section details the dust concentration in the work environment of the participating factories. The dust concentration in the work environment of Factory A is presented in table 11. As shown in this table, whilst the total dust concentration and cotton dust concentration in Factory A is low; dust concentration

Impact on	Yes	No
Career development	63	12
Family life	67	8
Social Life	58	17

Table 10: Impact of respiratory problems on career development, and family and social life. (Source: Survey data).

Type of Dust	Factory A	Factory B	Factory C
Total dust concentration	0.16 mg/m3	0.24 mg/m3	0. 36mg/m3
Cotton dust concentration	0.10 mg/m3	0.18 mg/m3	0.20 mg/m3

Table 11: Dust concentration in the work environment of Factory A, B and C. (Source: Air Sampler).

levels in Factory B and C are high. The main reason for the high dust concentration in Factories B and C can be attributed to the limited dust removal methods employed by these two factories, in comparison to the strategies employed by Factory A.

Conclusions

Main aim of this study was to address the dearth of research by assessing the extent of respiratory diseases amongst Sri Lankan apparel workers. Findings from this study indicate that whilst 75 participants (21 percent of the sample population) had experienced respiratory problems over the last 12 months. In terms of the factories, a large majority of the participants from Factory C reported experiencing respiratory problems, followed by those in Factory B. What is interest in this finding is the fact that whilst the sample consisted of a large number of participants from Factory A (199 participants, compared to 98 participants from Factor B and 58 participants from Factory C), the number of participants from Factory A who reported experiencing respiratory problems is much smaller than the number of participants who reported respiratory problems from Factory B and C. The main reason for the low number of employees with respiratory problems in Factory A in comparison to Factory B and C can be attributed to the low dust concentration levels in this factory. Findings from this study indicate that dust concentration levels in Factory A was extremely low i.e. 0.16 mg/m3, followed by total dust concentration in Factory B. Factory C had the highest dust concentration i.e. 0.36 mg/m^3 and 0.20 mg/m^3 which was on par with the maximum permissible levels for the industry.

Assessing if there is a direct link or correlation between worker exposure to cotton, hemp and other dusts particles and respiratory diseases in the industry was another key objective of this study. Findings from the study indicate that there is a clear link between exposure to cotton and other types of dusts and respiratory disease in the Sri Lankan apparel industry. This link is supported by the fact that low total dust concentration has resulted in low respiratory problems amongst workers in Factory A over the last 12 months, whilst high total dust levels in Factory C has resulted in high occurrences of respiratory diseases in workers from this factory. This finding is support by data that indicates that a majority of respondents who reported experiencing respiratory problems only experienced these problems after joining the industry, these respiratory symptoms increase when the participants first enters the workplace, and reduces when the participant is away from the workplace.

Conflict of Interest

No conflicts of interest to disclose.

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