Original Article

RESPIRATORY HEALTH PROBLEMS AMONG SPINNING MILL WORKERS

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Abstract

Background: Occupational respiratory diseases are significant public health concerns, particularly in the textile industry, where cotton dust exposure in spinning mills often leads to respiratory problems. Workers in spinning mills are at high risk of developing symptoms such as cough, breathlessness, and chest tightness due to prolonged exposure to cotton dust.

Methods: This cross-sectional study was conducted from January to December 2021 at Top Spinning Mill, located within Alauddin Textile Mill, Tangail district. A purposive sampling method was used to select 278 respondents directly involved in the spinning process, stratified by working sections. Participants included male and female workers aged 19 years or older with at least one year of employment. A semi-structured questionnaire based on the ATS standard questionnaire was used to collect data, alongside spirometry to assess lung function and PM2.5 and PM10 measurements across sections.

Results: Among the 278 respondents, 68% were female, with a mean age of 32.96 ± 10.67 years, a mean income of 6813.92 ± 3115.00 BDT, and an average employment duration of 6.38 ± 4.14 years. Smoking prevalence was 11.9%. Nearly 46% reported respiratory health problems, with cough (43.2%) being the most prevalent symptom. Spirometry revealed 12.2% had reduced FEV1, while 10.8% showed a reduced FEV1/FVC ratio. PM2.5 and PM10 levels were highest in the Blow Room. Significant associations were found between respiratory health problems and age, working section, and employment duration.

Conclusion: High respiratory health issues were observed among spinning mill workers, particularly in sections with elevated PM2.5 and PM10 levels. Health awareness programs and improved workplace supervision are recommended to mitigate respiratory problems and create a safer working environment.

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INTRODUCTION

Occupational respiratory diseases pose a significant public health challenge, particularly in industries where workers are exposed to airborne contaminants[1-4]. In the textile sector, spinning mills, which handle raw cotton and other fibers, generate significant amounts of cotton dust[5,6]. This dust, composed of organic, inorganic, and microbial particles, poses severe health risks to workers, including chronic respiratory conditions[7-9]. Among the major respiratory symptoms associated with cotton dust exposure are cough, phlegm, chest tightness, breathlessness, and wheezing[10-14]. Chronic exposure may lead to Byssinosis or other obstructive pulmonary diseases, significantly affecting lung function[15]. The adverse effects of cotton dust exposure have been recognized since the 19th century, with early documentation by Dr. James Philips Kay describing respiratory symptoms among cotton mill workers[16]. Despite technological advances and stricter regulations in developed countries, respiratory health problems remain a persistent concern in developing nations like Bangladesh due to limited preventive measures and underreporting[23]. Bangladesh's textile industry is vital to its economy, contributing 80% of the country's export earnings and employing 3.5 million workers, 80% of whom are women[17-19]. Among its sub-sectors, spinning mills represent a critical point of cotton dust exposure, particularly in processes such as blow room,

carding, and roving. However, research focusing exclusively on the respiratory health of spinning mill workers is limited, despite evidence indicating high levels of particulate matter (PM2.5 and PM10) in these environments[20-22]. This study aims to assess respiratory health problems among spinning mill workers in Bangladesh, identify related sociodemographic and occupational factors, evaluate lung function using spirometry, and measure particulate matter levels in different sections of the mill.

METHODS

This cross-sectional study was conducted from January to December 2021 at Top Spinning Mill, situated within Alauddin Textile Mill in the Vatkura area of Tangail district, Bangladesh. The study included workers aged 19 years or older who were employed for at least one year and directly involved in spinning processes. A total of 278 participants were selected using purposive sampling, ensuring representation from different working sections. Data were collected through face-to-face interviews using a semi-structured questionnaire modified from the American Thoracic Society (ATS) standard respiratory questionnaire. The questionnaire captured sociodemographic details, occupational factors, and respiratory symptoms, including cough, phlegm, chest tightness, breathlessness, and wheezing. Spirometry testing was conducted to assess lung function, measuring Forced Expiratory Volume in the first second (FEV1), Forced Vital Capacity (FVC), and the FEV1/FVC ratio. Each participant's best spirometry effort was recorded following ATS guidelines to ensure accuracy. Environmental monitoring of particulate matter (PM2.5 and PM10) concentrations was conducted in various working sections, such as the Blow Room and Carding Room, using standard air quality monitoring equipment. PM levels were measured continuously over seven days to capture variations in air quality across sections. The questionnaire was pre-tested to ensure clarity and reliability. The data were analyzed using SPSS version 26 to explore associations between respiratory health outcomes and sociodemographic, occupational, and environmental factors, providing insights into the health impacts of cotton dust exposure among spinning mill workers.

RESULTS

The study included 278 respondents, with ages ranging from 19 to 70 years. The mean age was 32.96 ± 10.67 years, with 32.01% aged 31–40 years, 31.65% aged 21–30 years, 21.95% aged 41 years or above, and 14.39% aged 20 years or below. The majority (68%) were female, while 32% were male. Regarding religion, 94.6% identified as Muslim, and 5.4% as Hindu. In terms of educational attainment, 33.81% of respondents were illiterate, while 66.19% were literate. Among the literate group, 32.02% had primary-level education, 26.61% had secondary-level education, and 7.56% had completed higher secondary or other forms of education. Marital status revealed that 74.1% of respondents were married, while 25.9% were single, widowed, separated, or divorced. The mean monthly income of respondents was 6813.92 ± 3115.00 Bangladeshi Taka (BDT), with income ranging from 4500 to 22,000 BDT. The majority (74%) had a monthly income between 5001 and 10,000 BDT, while 17.27% earned 5000 BDT or below, and 8.3% earned 10,001 BDT or above. The sociodemographic characteristics of the respondents are presented in Table 1.

The study revealed several important findings related to the work-related variables, respiratory health status, and environmental exposures of spinning mill workers. Among the 278 respondents, 50% had been employed for less than five years, 31.65% for 6–10 years, and 18.35% for more than 11 years. The mean working experience was 6.38 ± 4.143 years, with a minimum of one year and a maximum of 14 years. A total of 87.8% of workers reported working more than 8 hours per day and more than 48 hours per week, while only 12.2% adhered to the standard 8 hours per day and 48 hours per week. The mean daily working hours were 10.43 ± 1.54, and the mean weekly working hours were 62.56 ± 9.226, with a range of 8–13 hours per day and 48–80 hours per week. None of the workers reported receiving any form of break during their shifts, and 87.4% engaged in overtime work. While 66.2% of the workers reported using face masks, 23.7% had a prior history of working in dusty environments, whereas 76.3% had no such history. Distribution of respondents by work related variables are summarizing in table 2.

The majority of workers (38%) were employed in the Ring section, followed by 24.5% in the Finishing section. Other sections included Rotor SN (7.2%), Simplex (6.8%), Recycling and Drawing (5.4%), Rotor BT (4.3%), Mixing (4%), Carding (2.5%), and Blow Room (1.8%). Sections such as the Blow Room and Carding were noted for their high levels of cotton dust exposure.

Respiratory health problems were reported by 46% of respondents, with cough being the most prevalent symptom (43.2%), followed by phlegm (16.9%), breathlessness (18%), chest tightness (9%), and

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wheezing (3.6%). Spirometry assessments revealed that 12.2% of respondents had reduced FEV1 values (below 80% of the percent predicted value). All participants had normal FVC values (≥80%), while 10.8% demonstrated reduced FEV1/FVC ratios (<0.7), indicative of obstructive lung function patterns.

Environmental monitoring identified significant variations in particulate matter (PM2.5 and PM10) concentrations across different sections of the spinning mill. The highest levels were recorded in the Blow Room, with PM2.5 reaching 242 µg/m³ and PM10 reaching 275 µg/m³, exceeding occupational safety limits. Conversely, the Ring section reported the lowest PM2.5 (39 µg/m³) and PM10 (47 µg/m³) levels.

Statistical analyses revealed significant associations between respiratory health problems and variables such as age group, working sections, and employment duration ($p < 0.05$) (Table 3). Similarly, FEV1 status was significantly associated with age group, working sections, and employment duration (Table 4). The FEV1/FVC ratio also showed a strong correlation with working sections, particularly those with higher dust levels, such as the Blow Room and Carding sections (Table 5).

Table 1. Distribution of the respondents by sociodemographic characteristics

Variables	Frequency		Percentage
Age (in years)	≤20	40	14.39%
	21-30	88	31.65%
	31-40	89	32.01%
	≥41	61	21.95%
Gender	Male	89	32%
	Female	189	68%
Religion	Muslim	263	94.6%
	Hindu	15	5.4%
Educational qualification	Illiterate	84	33.81%
	Primary	89	32.02%
	Secondary	74	26.61%
	Higher secondary & other	21	7.56%
Marital status	Single	72	25.9%
	Married	206	74.1%
Income (in taka)	≤ 5000	48	17.27%
	5001-10000	207	74.46%
	≥ 10001	23	8.3%
Mean age	32.96 ± 10.671 years	Minimum 19 years	Maximum 70 years
Mean income	6813.92 ± 3115.002 taka	Minimum 4500 taka	Maximum 22000 taka

Table 2. Distribution of respondents by work related variables and their characteristics

Variables	Frequency		Percentage
Duration of employment	Less than 5 years	139	50%
	6-10 years	88	31.65%
	More than 10 years	51	18.35%
Work hour per week	48 hours	34	12.2%
	More than 48 hours	244	87.8%
Work hour per day	8 hours	34	12.2%
	More than 8 hours	244	87.8%
Breaktime	No	278	100%
Overtime	Yes	243	87.4%
	No	35	12.6%
Face mask	Yes	184	66.2%
	No	94	33.8%
Previous work history in dusty environment	Yes	66	23.7%
	No	212	76.3%
Mean duration of employment	6.38 ± 4.143 years	Minimum 1 year	Maximum 14 years
Mean work hour per week	62.56 ± 9.226 hours	Minimum 48 hours	Maximum 80 hours
Mean work hour per day	10.43 ± 1.54 hours	Minimum 8 hours	Maximum 13 hours

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Table 3. Association between working section and respiratory health problem

Working sections	Respiratory health problem		Total	Significance
	Yes	No		
Mixing	4 (36.4%)	7 (63.6%)	11 (100%)	X^2=25.014 df=9 p=0.003
Blow room	2 (40%)	3 (60%)	5 (100%)	
Carding	4 (57.1%)	3 (42.9%)	7 (100%)	
Drawing	15 (100%)	0 (0%)	15 (100%)	
Simplex	7 (36.8%)	12 (63.2%)	19 (100%)	
Ring	49 (46.2%)	57 (53.8%)	106 (100%)	
Finishing	28 (41.2%)	40 (58.8%)	68 (100%)	
Rotor BT	8 (66.7%)	4 (33.3%)	12 (100%)	
Rotor SN	7 (35%)	13 (65%)	20 (100%)	
Recycling	4 (26.7%)	11 (73.3%)	15 (100%)	

Table 4. Association between FEV_1 status and age group

FEV_1 status	Age group				Total	Significance
	20 years and below	21-30 years	31-40 years	41 years and above		
Reduced (less than 80%)	1 (2.9%)	2 (5.9%)	12 (35.3%)	19 (55.9%)	34 (100%)	X^2=32.123 df=3 p=0.00
Normal (80% and more)	39 (16%)	86 (35.2%)	77 (31.6%)	42 (17.2%)	244 (100%)	

Table 5. Association between working sections and FEV_1/FVC status

Working sections	FEV_1/FVC Status		Total	Significance
	Reduced (Less than 70%)	Normal (70% or greater)		
Mixing	1 (9.1%)	10 (90.9%)	11 (100%)	p=0.028*
Blow room	1 (20%)	4 (80%)	5 (100%)	
Carding	2 (28.6%)	5 (71.4%)	7 (100%)	
Drawing	3 (20%)	12 (80%)	15 (100%)	
Simplex	6 (31.6%)	13 (68.4%)	19 (100%)	
Ring	12 (11.3%)	94 (88.7%)	106 (100%)	
Finishing	3 (4.4%)	65 (95.6%)	68 (100%)	
Rotor BT	0 (0%)	12 (100%)	12 (100%)	
Rotor SN	1 (5%)	19 (95%)	20 (100%)	
Recycling	1 (6.7%)	14 (93.3%)	15 (100%)	

DISCUSSION

This study revealed a high prevalence of respiratory health problems (46%) among spinning mill workers, with cough (43.2%) being the most common symptom, followed by phlegm, breathlessness, chest tightness, and wheezing. These findings are consistent with a study in Zambia, where cough (19.9%) and chest tightness (14.5%) were reported as the most prevalent symptoms among spinning mill workers[1]. Similarly, a study in Nigeria reported significant respiratory symptoms, with rhinitis (59.2%) and cough (28.5%) being the most frequent complaints[2]. However, the prevalence of wheezing and chest tightness in this study (3.6% and 9%, respectively) was lower than the 22.5% chest tightness observed in Nigeria[2].

The association of respiratory health problems with high-dust working sections, such as the Blow Room, aligns with findings from China and Ethiopia, which demonstrated significant exposure-response relationships between cotton dust levels and respiratory symptoms[7,8]. This study's findings of reduced FEV1 (12.2%) and FEV1/FVC ratios (10.8%) are comparable to the results of Mansouri et al., who reported significant declines in FEV1 and obstructive patterns among cotton workers[3]. However, the relatively lower prevalence of obstructive lung patterns in this study may be due to the younger

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workforce and shorter employment durations. Environmental assessments showed that the Blow Room had the highest PM2.5 and PM10 levels, similar to results reported by Ahasan et al. and Zele et al., emphasizing the urgent need to mitigate dust exposure[5,8]. Variations in study findings may be explained by differences in methodologies, sample sizes, occupational practices, and the implementation of dust control measures.

CONCLUSION

The study identified a high prevalence of respiratory health problems among spinning mill workers, with significant associations between these problems and occupational factors such as working sections, dust exposure, and employment duration. Effective interventions, including workplace dust control, proper use of protective equipment, and regular health monitoring, are essential to safeguard worker health and prevent long-term respiratory complications.

Limitations

The study was conducted in a single spinning mill, limiting the generalizability of the findings. Self-reported symptoms may have introduced recall bias, and environmental measurements were limited to a specific timeframe.

Recommendations

- Implement regular health monitoring through periodic medical examinations, including respiratory assessments.
- Ensure mandatory use of personal protective equipment, including face masks, with proper training for workers.
- Limit excessive working hours and provide adequate break times for workers.
- Conduct awareness programs to educate workers about workplace hazards and preventive strategies.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board (IRB) of the National Institute of Preventive and Social Medicine (NIPSOM). The code of approval was: NIPSOM/IRB/2021/18.

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