Section: Community Medicine

Original Research Article

RESPIRATORY SYMPTOM PROFILE IN THE SUGAR INDUSTRY WORKFORCE

Hariharan Suresh[1], Vinothini Asaithambi[2], Ramesh Harihara Iyer[3], Kumudha G[4]

[1]Assistant Professor, Department of Community Medicine, Trichy SRM Medical College Hospital and Research Centre, Tiruchirappalli, Tamil Nadu, India.
[2]Senior Resident, Department of Paediatrics, Trichy SRM Medical College Hospital and Research Centre, Tiruchirappalli, Tamil Nadu, India.
[3]Professor and Head of Department, Department of Community Medicine, Tagore Medical College and Hospital, Chennai, Tamil Nadu, India.
[4]Post Graduate, Department of Community Medicine, Shri Sathya Sai Medical College and Research Institute, Sri Balaji Vidyapeeth University, Ammapettai, Tamil Nadu, India.

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Corresponding Author:
Dr. Hariharan Suresh,
Email: handy31088@gmail.com

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Abstract

Background: Occupational health represents a vital field dedicated to the protection of workers' physical, mental and social well-being. Within the agricultural sector, respiratory diseases, such as chronic obstructive pulmonary disease (COPD) and asthma, are particularly prevalent among those exposed to organic dust. The sugar industry (which serves as a significant global economic contributor) exemplifies the occupational health risks linked to exposure to sugarcane dust, especially bagasse. This study examines the prevalence and severity of respiratory symptoms among sugar factory workers in Tamil Nadu, India; however, the findings may have broader implications for similar industries **Materials and Methods:** A cross-sectional study was conducted among 272 eligible sugar factory workers in Tamil Nadu. Workers who had at least one year of factory experience participated; however, those with recent medical complications or pregnancy were excluded. Data were collected through structured interviews using the American Thoracic Society (ATS) Division of Lung Diseases (DLD-78) questionnaire. This tool assessed chronic respiratory symptoms, occupational exposure, smoking habits and family histories. Workers were categorized into mild, moderate and severe exposure groups based on their job roles. **Result:** Respiratory symptoms were reported by 50.4% of workers, with phlegm being the most common symptom (31.3%), followed by allergic rhinitis (30.1%) and cough (29.8%). Breathlessness and wheezing were documented in 10.7% and 7.7% of participants, respectively. Workers exposed to severe dust levels exhibited a higher prevalence of symptoms, although protective measures were scarcely adopted, because 71.3% never used respiratory masks. A significant proportion of workers (32.8%) experienced symptom relief after being away from the work environment for two weeks. **Conclusion:** Chronic exposure to sugarcane dust has a significant impact on the respiratory health of sugar factory workers. The study underscores the urgent necessity for enhanced occupational safety practices and regular health assessments to mitigate risks and promote worker well-being.

INTRODUCTION

Occupational environments possess distinct health effects that have been acknowledged for centuries. The domain of occupational health, as articulated in 1950 by a collaborative committee of the International Labour Organization (ILO) and the World Health Organization (WHO), seeks to safeguard and promote the physical, mental and social well-being of workers across diverse industries.[1] Notably, diseases associated with agriculture and its related sectors were among the earliest recognized occupational ailments; this is evidenced by Olaus Magnus's 1555 documentation, which cautioned against the inhalation of grain dusts.[2] Bernardino Ramazzini, often regarded as the "father of occupational medicine," further highlighted the dangers of respiratory illnesses in his 1700 treatise, De Morbis Artificum Diatriba (Diseases of Workers). Today, statistics indicate that occupational diseases and injuries result in over 2 million fatalities annually.[3] Respiratory afflictions, such as chronic obstructive pulmonary disease (COPD) and asthma, significantly contribute to this

grim toll. However, the ongoing exploration of these health impacts remains crucial.

The sugar (induitical) sector within agriculture exemplifies the intricate interplay between industrial growth and worker health. A substantial contributor to global economies, sugar production has experienced a remarkable increase in output, soaring from 73 million tonnes in 1970 to 180 million tonnes in 2014 (this is significant).[4] Sugarcane serves as its primary source. India, which ranks second in sugar production, sustains a vast workforce of approximately 500,000 skilled and unskilled laborers; Tamil Nadu and Pondicherry collectively contribute to 20.3% of the national sugarcane output across 2.4 million hectares.[5] However, despite its economic significance, the industry's rapid expansion has come at a considerable cost to workers' health. In India—where the industry is central to rural and agricultural livelihoods—worker health and safety remain significantly under-monitored because basic health rights are often neglected. Although the sector thrives, the well-being of its labor force is frequently overlooked.

Health risks associated with sugar production are particularly pronounced; workers face hazards ranging from musculoskeletal strain to noise-induced hearing loss, as well as respiratory diseases. Sugarcane processing entails significant exposure to organic dust and other airborne particles, especially bagasse (a by-product of sugarcane crushing), which is frequently inhaled by workers in the factory setting. Prolonged exposure to bagasse dust is linked to hypersensitivity pneumonitis—a condition referred to as "bagassosis"—and can result in restrictive lung impairments among affected individuals.[6,7] Past studies highlight the correlation between dust exposure and diminished pulmonary function, particularly emphasizing symptoms such as chronic cough and wheezing among impacted workers.[8,9] The current study aims to contribute to the existing body of research investigating respiratory impairments within the sugar industry workforce; it focuses specifically on the prevalence and severity of impairments among workers exposed to bagasse dust. However, this line of inquiry is essential for understanding the broader implications of occupational health in this sector, because it sheds light on the urgent need for improved safety measures.

MATERIALS AND METHODS

This study sought to ascertain the prevalence of respiratory symptoms among employees at a sugar manufacturing facility in Villupuram, Tamil Nadu. Conducted as a cross-sectional inquiry, data were obtained from 272 eligible individuals out of a total of 283 workers employed at the site, deliberately omitting those who had recently undergone surgery or suffered heart attacks. Eligible participants were defined as those with a minimum of one year of work experience at the factory; however, pregnant or lactating women, along with individuals who had encountered recent health complications, were excluded from participation. Data collection was executed through a structured interview format, which was systematically divided into seven distinct sections. The initial segment encompassed demographic and socioeconomic backgrounds, succeeded by an exploration of occupational history. Personal health history—particularly regarding smoking and alcohol consumption—was thoroughly examined, alongside an assessment of respiratory symptoms as per the American Thoracic Society (ATS) respiratory questionnaire. This particular instrument facilitated the collection of data relating to chronic respiratory conditions, including asthma, wheezing and various other pulmonary ailments. Furthermore, it encompassed inquiries into the participants' occupational exposure, familial history and smoking practices.

Respiratory symptoms were evaluated through the American Thoracic Society (ATS) Division of Lung Disease (DLD-78) questionnaire, a rigorously validated instrument designed to assess chronic respiratory concerns such as coughing, phlegm production, wheezing and dyspnea. The questionnaire was further augmented to elicit comprehensive information regarding historical respiratory ailments, including asthma, chronic bronchitis and emphysema, as confirmed by medical professionals. Occupational history, exposure variables, smoking behaviors and familial history of respiratory disorders were encompassed within this tool, thereby bolstering the study's aim of scrutinizing the occupational ramifications on pulmonary health.

The data collection process was (carefully) structured; workers were individually escorted to the factory's dispensary for interviews, clinical examinations between 9:00 AM and 3:00 PM, conducted under controlled environmental conditions. Exposure levels to sugarcane dust were classified according to job roles, which ranged from mild exposure for office personnel to severe exposure for individuals working in manufacturing sectors. However, it is crucial to note that these distinctions are based on the nature of the work performed and this categorization is essential for understanding the associated health risks.

RESULTS

The investigation concentrated on a cohort of 272 sugar factory laborers, whose ages ranged from 22 to 59 years, yielding a mean age of 42.7. Predominantly, the participants were male (92.8%) and a significant proportion exceeded the age of 41 years (60.6%). In terms of educational attainment, a substantial 69.9% of these workers had at least completed high school, whereas a mere fraction (3.7%) were classified as illiterate. Socioeconomic status further delineated the group; a majority of participants (77.2%) were categorized within class II or higher according to the

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modified BG Prasad classification, with no individuals residing in the lowest class, thereby indicating a predominantly middle to upper socioeconomic standing. Employment characteristics revealed that nearly half of the workforce (50.3%) possessed over 15 years of experience and 13.6% were engaged in 12-hour work shifts. A noteworthy subset, 40.1%, were seasonal employees, contracted for nine months each year, many of whom had accrued relevant occupational experience pertinent to their factory responsibilities. Exposure to cane dust exhibited considerable variability: 41.5% of workers encountered mild exposure, 17.6% faced moderate exposure and 40.9% found themselves in areas of severe exposure. These assorted demographics and occupational factors established a critical basis for evaluating respiratory health risks among this workforce.

The comprehensive prevalence of respiratory symptomatology was determined to be 50.4%; in other words, 137 individuals within the study cohort acknowledged experiencing at least one respiratory ailment. Notably, phlegm emerged as the predominant symptom, reported by 85 workers (31.3%), followed closely by allergic rhinitis, which affected 82 workers (30.1%) and cough, noted by 81 workers (29.8%). Additionally, breathlessness was documented in 29 workers (10.7%), while wheezing was reported by 21 (7.7%), haemoptysis by 10 (3.7%), epistaxis by 5 (1.8%) and the least frequently mentioned symptom was chest tightness, affecting 2 workers (0.7%). It is significant to point out that none of the participants reported symptoms indicative of stridor or pleuritic chest pain. Furthermore, the overall prevalence of respiratory symptoms among females was recorded at 61.9% (13 out of 21 females). The most frequently reported symptom in this subgroup was phlegm, accounting for 42.9%. However, while these findings provide valuable insights into the health challenges faced by workers, the implications of such high prevalence rates warrant further investigation into potential causal factors and preventive measures.

The overall prevalence of symptoms of respiratory problems was found to be 50.4% in other words 137 workers in the study population reported having at least one symptom of respiratory problem. In this study phlegm was the most reported symptom by 85 (31.3%) workers, followed by allergic rhinitis in 82 (30.1%) workers and cough in 81 (29.8%) workers. Breathlessness was reported in 29 (10.7%), wheezing in 21(7.7%), haemoptysis in 10 (3.7%), epistaxis in 5 (1.8%) and the least reported symptom was chest tightness in 2 (0.7%) workers. None of the workers reported symptoms of stridor or pleuritic chest pain. The prevalence of various possible symptoms of respiratory problems are given in figure 1.

The overall prevalence of the symptoms of respiratory problems among females was found to be 61.9% (13 out of 21females). The most common symptom was phlegm among 42.9%.

Details of symptoms of respiratory problems:

In the present investigation, a total of 68 workers (representing 83.9%) exhibiting cough reported experiencing this symptom between 4 to 6 times daily. Of these individuals, 31 (or 38.2%) experienced coughing episodes both during the day and at night, while merely 16 (19.6%) had a persistent cough for three or more months annually. Furthermore, seventy-two workers (84.7%) with phlegm reported experiencing this symptom at least twice a day or for four or more days each week. Notably, among these subjects, 48 (56.4%) reported the presence of morning phlegm. However, only 22 workers (25.9%) indicated that they experienced phlegm on most days for three or more months each year. Interestingly, seventeen workers (80.9%) experienced wheezing solely during cold weather. Additionally, among those workers suffering from breathlessness, 17 (58.6%) walked at a slower pace than peers of the same age on a level surface and 6 (20.6%) were observed to pause for breath while walking at their own pace on a flat terrain. Although a segment of the workforce presented with respiratory issues, 45 workers (32.8%) reported a notable alleviation of symptoms after being away from work for two weeks; moreover, none of the workers indicated a worsening of their symptoms during this period.

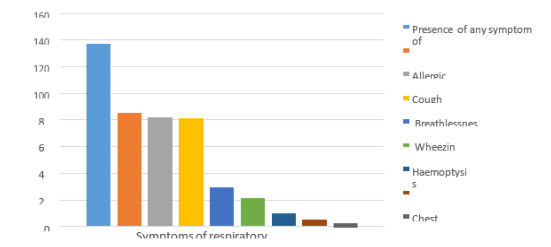

Figure 1: Prevalence of Respiratory Symptoms

Table 1: Background Characteristics of the Study Participants

Characteristics	No. of participant (N =272)	Percentage
Age group in years:		
21 to 30	52	19.1
31 to 40	55	20.2
41 to 50	86	31.6
51 to 60	79	29.1
Education:		
Illiterate	10	3.7
Primary School	31	11.4
Middle School	41	15.1
High School	62	22.8

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Post High School Diploma	42	15.4
Graduate	56	20.6
Post Graduate	30	11
Exposure to sugarcane dust		
Mild	134	49.3
Moderate	48	17.6
Severe	90	33.1
No. of years of work:		
≤10 years	110	40.4
11 to 20 years	72	26.5
21 to 30 years	65	23.9
≥31 years	25	9.2
No. of hours of work every day:		
8 hours per day	235	86.7
More than 8 hours per day	37	13.6
Type of work:		
Permanent	163	59.9
Seasonal	109	40.1
Tobacco Smoking		
Current smoker	55	20.2
Ex-smoker	28	10.3
Never	189	69.5
Alcohol Consumption		
Current drinker	108	39.7
Ex – alcoholic	30	11
Never	134	49.3
Using airway protection while at work:		
Most of the time	23	8.5
Once in a while	55	20.2
Never	194	71.3
Using gloves while at work		
Most of the time	23	8.5
Once in a while	48	17.6
Never	201	73.9

Table 2: Respiratory Symptom Profile of the workers (Based on responses of ATS – DLD 78)

S.no	Particulars	No. of workers	Percentage
1	Cough (N = 81)		
	Cough 4-6 times a day or 4 or more days a week	68	83.9
	Morning cough	43	53.1
	Cough day and night	31	38.2
	Cough on most days for 3or more months a year	16	19.6
	Duration of cough for 3 or more months a year (n= 16)		
	≤ 2 years	5	31.3
	>2 years	11	68.7
2	Phlegm (N = 85)		
	phlegm twice a day or 4 or more days a week	72	84.7
	Morning phlegm	48	56.4
	Phlegm day and night	34	40
	Phlegm on most days for 3 or more months a year	22	25.9
	Duration of phlegm for 3 or more months a year		
	≤ 2 years	8	36.4
	>2 years	14	63.6
3	Cough and phlegm for 3 or more weeks a year (n =272)	38	13.9
4	Wheezing (n=21)		
	During cold	17	80.9
	Occasionally apart from cold	11	52.3
	Most day or night	5	23.8
	Duration of wheezing in years		
	≤ 4 years	13	61.9
	>4 years	8	38.1
5	Breathlessness (n=29)		
	Short of breath when hurrying on level ground or walking up a slight hill (n=272)	29	10.7
	Walk slower than people of same age on the level because of breathlessness	17	58.6
	Stop for breath when walking at own pace on the level	6	20.6
	Stop for breath after walking a few minutes on the level	4	13.7
	Breathless to leave the house or on dressing and undressing	0	0
6	Wheeze and breathlessness (n=272)	8	2.9
7	H/O symptom relief on being away from work for a fortnight (n = 137)		
	Better	45	32.8
	Unchanged	92	67.2

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Table 3: Association between various characteristics and presence of symptoms of respiratory problems

Characteristic	N	Symptoms of respiratory problems		Odds Ratio	95% CI
		Present	Absent		
Age >35 years	183	84	99	0.57	0.34 to 0.96
Age ≤35 years	89	53	36		
Working >15 years in the factory	137	69	68	1.03	0.63 to 1.66
Working ≤15 years in the factory	135	66	67		
Smoker	83	44	39	1.16	0.69 to 1.95
Non – smoker	189	93	96		
Airway Protection Non – user	194	109	85	2.28	1.33 to 3.93
Airway Protection User	78	28	50		
Moderate & Severe Exposure to Cane Dust	138	93	45	4.22	2.55 to 7.02
Mild Exposure to Cane Dust	134	44	90		

DISCUSSION

In the current investigation, manifestations of respiratory distress were observed among 50.4% of the labor force. The predominant symptom articulated was phlegm (31.3%), followed by cough (29.8%) and breathlessness (10.7%), with wheezing occurring in 7.7% of the participants. In a separate study conducted by Ahasan et al. in Bangladesh, 42.9% of garment industry workers reported experiencing cough, whereas only 4.3% encountered breathlessness.[10] Additionally, research by Francis NDE et al. involving individuals exposed to wood dust indicated that 34.5% experienced cough, while 30% reported rhinitis.[11] Furthermore, a study by P. Vaidya et al. identified a prevalence of chronic respiratory symptoms at 28.4% among educators in Shimla.[12] The observed discrepancies in symptom prevalence across diverse studies may be attributable to variations in climatic conditions, the size of the dust particles to which individuals are exposed and the duration of such exposure, among other factors intrinsic to the different research environments. However, this complexity underscores the need for further investigation into these environmental influences.

The investigation conducted by Anand B. Singh et al. revealed that the prevalence of respiratory illness symptoms among sugar refinery workers is approximately 42.5%.[13] This figure bears a slight resemblance to the findings of the current study. In the aforementioned research, which focused on various agro-based industry workers, the highest prevalence of such symptoms was observed among poultry farm workers (59%), while the lowest was among bakers (40.1%). Cough emerged as the predominant symptom among sugar refinery personnel, with 38% of the workforce reporting its occurrence, a statistic that represented the highest prevalence when compared to workers from bakeries, granaries and poultry farms. Furthermore, breathlessness was noted in 10% of these workers, while 18% reported symptoms consistent with allergic rhinitis within the sugar refinery context. The disparity in respiratory illness symptom prevalence between poultry farm workers and those in the sugar industry may be attributed to exposure to infectious dust particles prevalent in poultry environments (this is exacerbated by inadequate ventilation). Conversely, the variance in symptom prevalence between granary workers and those in the sugar industry can be explained by the absence of grinding or crushing processes in granaries, which consequently results in a diminished quantity of fine respirable dust. Thus, although the data presents some compelling correlations, further investigation is warranted to elucidate the underlying causative factors.

In the current investigation, a significant 83.9% of the workers exhibiting cough reported experiencing this symptom between four to six times daily. Notably, 38.2% of these individuals experienced coughing both during the day and at night; however, only 19.6% reported enduring this symptom for three or more months annually. Furthermore, 84.7% of the workers suffering from phlegm experienced this symptom at least twice each day or four or more days per week. Among these individuals, 56.4% reported the presence of morning phlegm. On the contrary, only 25.9% of the workers experienced phlegm on most days over a span of three or more months each year. Additionally, 80.9% of the workers reported wheezing exclusively during periods of cold weather. It is worth noting that 58.6% of the workers with breathlessness exhibited a slower walking pace compared to peers of the same age on level ground, while 13.4%.

A significant portion of the labor force was observed to pause for respiration while ambulating at their own pace on level terrain. Furthermore, among those workers exhibiting symptoms indicative of respiratory illness, approximately 32.8% reported experiencing alleviation from these symptoms after being away from work for a fortnight. A study conducted by P. Vaidya et al. indicated that 8.4% of educators experienced a persistent cough for three or more months annually over the preceding two years.[12] This information regarding a comprehensive account of the diverse symptoms encountered by workers in the sugar industry has not been adequately addressed in any of the studies that were reviewed. In the present investigation, 3.3% of the workforce reported a history of asthma, while 2.6% had previously been diagnosed with tuberculosis and 0.7% had a documented history of chronic bronchitis. Additionally, research conducted by Pravin N. Yerpude et al. in Andhra Pradesh revealed that 1.68%, 4.85% and 0.84% of workers

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were affected by asthma, chronic bronchitis and tuberculosis, respectively.[14]

In the current investigation, the manifestation of respiratory symptoms can be attributed to several factors: exposure to sugarcane dust within the work environment, inadequate ventilation, insufficient awareness regarding the criticality of utilizing personal protective equipment and substandard personal hygiene practices among the workforce. The laborers were encouraged to consult a physician for potential treatment and the significance of employing personal protective devices (such as gloves and respirator masks) during their duties was emphasized. Notably, the sugar industry, recognized as the second largest agro-based sector and the most systematically organized industry in India, employs approximately half a million individuals. The achievements of the sugar industry, however, have been realized at the expense of the health of its workers. Symptoms indicative of respiratory ailments and pulmonary dysfunction represent an area of considerable health concern within this demographic. Although few studies have been conducted to date to quantify the extent of these issues among sugar industry employees, this present study aims to address the existing knowledge deficit regarding the prevalence of respiratory symptoms and pulmonary impairment among workers at a sugar factory located in Tamil Nadu.

The occurrence of respiratory symptomatology in this investigation was identified as 50.4% (with phlegm representing the most frequently reported manifestation), which suggests that chronic exposure to cane dust in the occupational milieu significantly contributes to this issue. It is imperative, however, that factory management undertakes proactive measures to mitigate workers' exposure to cane dust. This can be achieved through the adoption of contemporary storage techniques for bagasse, as well as the enhancement of industrial hygiene practices. Furthermore, implementing stringent safety protocols is essential because the well-being of the workforce depends on it.

CONCLUSION

The study highlights a significant prevalence of respiratory symptoms among sugar industry workers in Tamil Nadu, with over half of the workforce experiencing at least one symptom. Chronic exposure to sugarcane dust and inadequate protective measures contribute heavily to this health burden. Phlegm, allergic rhinitis, and cough were the most frequently reported symptoms, demonstrating the occupational risks associated with sugarcane dust exposure. Notably, workers with severe exposure exhibited a higher prevalence of symptoms, emphasizing the critical need for mitigating exposure levels. The various steps that can be taken to reduce the impact of the problem includes proper training on need and how to use the personal protective equipment (PPE) at work, ensuring availability and usage of PPE, etc. Lastly further studies in similar settings would help in exploring the long-term health implications of sugarcane dust exposure among the sugar industry workers which might be helpful in developing the industry specific health and safety guidelines.

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