ORIGINAL ARTICLE

Bagasse dust related morbidities and its determinants among workers at sugarcane factory of District Saharanpur

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ABSTRACT

Introduction: India's sugarcane factories are growing by creating job opportunities for thousands of workers with varying educational, professional and socioeconomic backgrounds. These factories are a source of several hazards that severely harm the workers' health. **Aims & objectives:** To find prevalence of morbidities due to bagasse dust exposure among sugarcane factory workers and various factors associated with them. **Material and methods:** Cross sectional study was conducted in randomly selected Government sugarcane factory of District Saharanpur, among 343 factory workers for a period of one year. Pretested semi structured questionnaire was used to collect data. Collected data was analysed using appropriate statistical tests. **Result:** Overall prevalence of bagasse dust related morbidities was 29.2%. Maximum workers suffered from chronic cough (21.6%), chronic cough with breathlessness (2.3%), and chronic cough with phlegm (1.7%), chronic phlegm (1.5%), breathlessness (1.2%), wheeze (0.9%). These morbidities were significantly higher among those belonging to socioeconomic class III (37.4%)., working in processing section (68.4%) and those working for > 8 hours/day (38.7%). **Conclusion:** Occupational hazards have deleterious effect on the individual health and safety, and on organizational effectiveness. These are preventable to a larger extent. Regular training should be conducted to educate workers to adopt proper safety measures.

KEYWORDS

Sugarcane Factory; Occupational Health Problems; Bagasse Dust; Determinants

INTRODUCTION

The sugarcane industry plays a crucial role in the economy of nation, especially in rural areas, by providing employment and contributing to local development. The biggest sugarcane producer in the world is Brazil followed by India mainly Maharashtra, China and Thailand (1). Workers in this sector face numerous occupational health hazards such as noise, heat and respiratory problems from dust and particulate matter (2). Roughly 30% to 50% of workers are expose to occupational health hazards and as estimated by WHO about 120 million of occupational injuries resulting in 200,000 fatalities annually (3). The 2030 Sustainable Development Goals (SDGs) aim to "ensure healthy lives and promote well-being" and "decent work" for all whatever their economic or social status (4). Exposure to bagasse dust leads to chronic respiratory infections, such as bagassosis, extrinsic allergic alveolitis and organic dust toxic syndrome, affecting workers' health, reducing productivity, and impacting their quality of life (5,6). In India, AB Singh and TS Pandit found that 42.5% of sugar refinery workers exposed to bagasse

developed respiratory problems (7,8). To highlight these issues this study was planned results of which will help in planning and implementing proper regulations in the factory to reduce work related hazards.

Aim and objective

1. To find out morbidities due to bagasse dust exposure among sugarcane factory workers.
2. To determine various factors associated with bagasse dust related morbidities among sugarcane factory workers.

MATERIAL & METHODS

Study design: Cross-sectional study

Study setting: Study was conducted in Sugarcane factory of district Saharanpur, Uttar Pradesh. There are total nine sugarcane factories in District Saharanpur. Among them 2 are government owned and 7 are privately owned. Out of these two government sugarcane factories named Kisan Sahkari Sugar factory, Nahunta and Kisan co-op sugar factory, Sarsawa. Out of these two one sugarcane factories was randomly selected. Thus, kisan co-op sugar factory, Sarsawa was selected.

Study duration: Study was conducted for a period of one year.

Study population: All workers, both male and female working in the sugarcane factory (such as general workers, administrative staff, technical staff and managerial staff including engineers, chemist, technician, electrician, workers, metal welders, house-keeping and others).

Inclusion criteria: Workers both male and female of all age groups.

Workers who were willing to participate and gave consent.

Exclusion criteria: Worker who showed hostile behaviour.

Workers who were disabled and had low intellectual level.

Workers suffering from life threatening chronic illnesses.

Sample size (selection of study participants): All the workers working in the sugarcane factory were included following inclusion and exclusion criteria. According to the records 400 workers were present at time of study but only 343 were interviewed. Out of these 57 workers who were not included, 27 did not give consent to participate, 3 workers had low intellectual level, 11 were either disabled or had chronic life-threatening illness, 16 gave incomplete information (agreed to participate earlier but then later refused to give information or were absent).

Study procedure: To conduct study in the Government sugarcane factory situated in Sarsawa block of District Saharanpur a written permission was taken from the management of the factory. Data collection was done taking into consideration the shift schedule of workers so that all workers who were working in different rotatory shifts were included. A predesigned, pre-tested, semi-structured questionnaire was used to collect information. Before data collection written informed consent was taken from the participants after explaining the purpose & procedure of the study. Confidentiality of data was maintained. Contact details were mentioned on the consent form for any assistance/query in the future.

Study tool: Questionnaire consisted questions on sociodemographic factors (age, marital status, religion education and socioeconomic status), information on work area sections in factory, working hours/day, years of work experience and morbidities due to bagasse dust.

Statistical analysis: Data collected was entered and analyzed using IBM SPSS statistics v20. Data management tools were utilized to avoid duplication and entry error. Inferential statistic such as Chi-square test/ Fisher exact test were used. The p value ≤ 0.05 was the cut off point for statistical significance. The study protocol was approved by the institutional ethical committee.

RESULTS

Present study was conducted among govt. sugarcane factory workers of Saharanpur district and a total of 343 workers were included in study. Majority workers were males (99.7%). The mean age of workers was 38.81 (±11.36 SD) years. Maximum number of workers were Hindus (84.5%) followed by Muslims (15.5%). Also, among the study population, 81.3% were married and 18.7% unmarried.

On analysing the effect of bagasse dust on sugarcane factory workers, it was observed that 29.2% of workers suffered from bagasse dust related morbidities. Chronic cough was most common morbidities separated effectively every fifth worker (21.6%). Along with cough, 1.5% had chronic phlegm, 1.2% had breathlessness, 0.9 % complained of wheeze, whereas 2.3% had chronic cough with breathlessness and 1.7% had both chronic cough with phlegm. (Table 1) On analysing association between bagasse dust related morbidities with age group among study population. Maximum prevalence of morbidities was in age group 31-40 years (31.2%), followed by 41-50 years (30.4%), 18-30 years (29.6%), 51-60 years (25.6%) and >60 years (9.1%). Prevalence of morbidities was more among Muslim workers (37.7%) than Hindu workers (27.6%). Almost equal prevalence was observed among married workers (29.4%) than unmarried workers (28.1%). Prevalence was also higher among those educated

up to intermediate (36.6%), followed by primary school (30.0%), high school (28.4%), graduate (27.3%), literate/ just literate (21.4), middle school (18.4%) and post graduate (10.0%). This difference in prevalence of bagasse dust related morbidities in relation to age group, religion, marital status and educational status of workers was not found to be statistically significant. It was also observed that significantly higher prevalence of morbidities was seen in those belonging to socioeconomic class III (37.4%), followed by class IV (22.8%). While in upper socioeconomic class morbidities were very less 12% class II and none in class I. (Table 2)

Among those workers working in different sections of sugarcane factory highest prevalence of morbidities was observed in those working in processing section (68.4%) followed by waste treatment plant (45.5%), warehouse (44.4%) and mill section (37.9%) while workers of other sections of factory were comparatively less morbid. This difference was found to be statistically significant. (Table 3).

On analysing the effect of working hours on development of morbidities, it was observed that workers who are engaged for less than 6 hours and more than 8 hours was more morbid (36.2% and 38.7% respectively) as compare to those who are working for 6-8 hours and difference was statistically significant. (Table 4)

When presence of bagasse dust related morbidities was analyzed in relation to working years of workers, it was observed that prevalence of morbidities increases with increase in working years with prevalence being 24.4% in less than 2 years & 39.7% in 6-10 years of working experience but this difference was statistically not significant.

Table 1: Distribution of study population according to bagasse dust related morbidities (N=343)

Bagasse dust related morbidities	Present		Absent	
	No.	%	No.	%
Chronic cough	74	21.6	269	78.4
Chronic Phlegm	05	1.5	338	98.5
Breathlessness	04	1.2	339	98.8
Wheeze	03	0.9	340	99.1
Chronic cough with phlegm	06	1.7	337	98.3
Chronic cough with breathlessness	08	2.3	335	97.7
Total	100	29.2	243	70.8

Table 2: Association of bagasse dust related morbidities with sociodemographic factors of study population (N=343)

Variable	Category	Bagasse dust related morbidities						Fisher's Exact Df, P value
		Yes		No		Total		2.502
		No.	%	No.	%	No.	%	4
Age group	18-30 years	29	29.6	69	70.4	98	28.6	0.651
	31-40 years	35	31.2	77	68.8	112	32.7	
	41-50 years	24	30.4	55	69.6	79	23.0	
	51-60 years	11	25.6	32	74.4	43	12.5	
	>60 years	01	9.1	10	90.9	11	3.2	
Religion	Hindu	80	27.6	210	72.4	290	84.5	2.235
	Muslim	20	37.7	33	62.3	53	15.5	1
								0.142
Marital status	Married	82	29.4	197	70.6	279	81.3	0.040
	unmarried	18	28.1	46	71.9	64	18.7	1
								0.880
Educational status	Illiterate/ just literate	03	21.4	11	78.6	14	4.1	8.191
	Primary school	03	30.0	07	70.0	10	2.9	6
	Middle school	09	18.4	40	81.6	49	14.3	0.216
	High school	21	28.4	53	71.6	74	21.6	
	Intermediate	48	36.6	83	63.4	131	38.2	
	Graduate	15	27.3	40	72.7	55	16.0	
	Professional/Post Graduate	01	10.0	09	90.0	10	2.9	

Socioeconomic status	Class I	0	0.0	01	100.0	01	0.3	12.844
	Class II	03	12.0	22	88.0	25	7.3	4
	Class III	64	37.4	107	62.6	171	49.9	0.005
	Class IV	33	22.8	112	77.2	145	42.3	
	Class V	0	0.0	01	100.0	01	0.3	

Table 3: Association of bagasse dust related morbidities with work area of study participants (N=343)

Variable	Category	Bagasse dust related morbidities						Fisher's Exact Df, P value
		Yes		No		Total		
		No.	%	No.	%	No.	%	
Work area	Boiler	01	5.0	19	95.0	20	5.8	
	Cane receiving /uploading section	02	11.1	16	88.9	18	5.2	
	Supervisor	01	12.5	07	87.5	08	2.3	
	Mill section	55	37.9	90	62.1	145	42.3	
	Other (lab, security, plumber, driver etc)	06	9.1	60	90.9	66	19.2	
	Power generation plant	04	14.8	23	65.2	27	7.9	49.570
	Processing (juice dilution, chemical areas, clarification)	13	68.4	06	31.6	19	5.5	80.001
	Ware house	08	44.4	10	55.6	18	5.2	
	Waste treatment plant	10	45.5	12	54.5	22	6.4	

Table 4: Association of bagasse dust related morbidities with working hour of study participants (N=343)

Working hours	Bagasse dust related morbidities						Chi square df P value
	Yes		No		Total		
	No.	%	No.	%	No.	%	
<6 hours(n=224)	81	36.2	143	63.8	224	65.3	25.842
6-8 hours(n=88)	07	8.0	81	92.0	88	25.7	2
>8 hours(n=31)	12	38.7	19	61.3	31	9.0	0.001
Total (343)	100	29.2	243	70.8	343	100	

Table 5: Association of bagasse dust related morbidities with work experience of study participants (N=343)

Working years of experience	Bagasse dust related morbidities						Chi square df P value
	Yes		No		Total		
	No.	%	No.	%	No.	%	
<2 years	19	24.4	59	75.6	78	22.7	5.618
3-5 years	25	30.9	56	69.1	81	23.6	3
6-10 years	27	39.7	41	60.3	68	19.8	0.133
>10 years	29	25.0	87	75.0	116	33.8	
Total (343)	100	29.2	243	70.8	343	100	

DISCUSSION

Occupation has a relationship on health and well-being and there are diverse aspects on the effect of occupation on health. In the present study majority of the workers were of age group 31-40 years (32.7%), followed by the 18-30 years (28.5%), 41-50 years (23%), 51-60 years (12.5%), and >60 years of age (3.2%). The mean age was 38.81years indicating a younger workforce in the factory. A similar study was done by Debela et al (9) in Ethiopia, concluded that the most of the workers were in age group 33-47 years were (49.3%), age >48 years (39.5), and 18-32 years (11.2%). While study done by Bisht et al (2016) (10) in Uttarakhand, found that most of the workers were in age group of 47-65 years (36%), followed by 37-46 years (35%), 57-66 years (14%), 27-36 years (8%) and 17-26 years (7%) only. This finding was not similar to the present study. The mean age concluded by Bisht et al (2016) (10) were 52 years and 50 years respectively which is more than the findings of present study. In the current study, the workers were mainly males 99.7% and only 0.3% were females. This finding is similar to the study conducted by Debela et al (9) in Ethiopia concluding that 96% were males and only 4% females. Also, Abdelwahab et al (11) and Masthi et al (2) concluded that 100% workers were males. This could be due to the nature of work in sugar cane factories which inhibits women from joining and working.

In the present study, the majority of the workers were Hindu (84.5%), followed by Muslims (15.5%).

This distribution reflects the regional demographic composition of Saharanpur and Uttar Pradesh, where Hindus form the majority of the population. Similar study done by Masthi et al (2) in Karnataka, concluded that 95.9% of the workers were Hindus and only 3.5% Muslims, indicating the similar trend in another major sugarcane-producing state.

In the present study, 81.3% of workers were married and only 18.7% were unmarried. In a study conducted by Debela et al (12) it was also found that 90.9% sugarcane factory workers were married and only 8.7% were unmarried which is closely aligned with the present study findings. While study conducted by Mersha et al (13) concluded more workers were unmarried (51.2%) in comparison to married workers (48.8%). This finding is not similar to the findings of the present study.
In the present study due to bagasse dust exposure workers suffered from various morbidities such as 21.6% had chronic cough, 1.5% had chronic phlegm, 1.2% had breathlessness, 0.9 % complained of wheeze, whereas 2.3% had chronic cough with breathlessness and 1.7% had both chronic cough with phlegm. Debela et al (9) reported higher results than the present study concluding that exposure level to bagasse dust was 85.52%. The level of chronic respiratory health symptoms was 60.6%. The most common respiratory symptoms were wheezing (96.8%), coughing (89.7%) and breathlessness (80.9%). Working in bagasse dust exposure leads to respiratory irritation and allergic reactions due to inhalation of fine dust particles, contaminated with microbial and long-term lung disease.

According to the findings of the present study maximum prevalence was in age group 31-40 years (31.2%), 41-50 yeas (30.4%), Muslim workers (37.7%), among those who were married (29.4%), those educated up to intermediate level (36.6%) and those belonging to socioeconomic class III (37.4%). These results were in accordance with the study done by Bansal et al (14) reporting that most of the morbidities found 28.9%, 27.7%, 38.3%, of the workers in the age group of 20-35, 36-50, 51-65 years respectively, that most productive age groups are most exposed to morbidities.

Maximum number of the bagasse related morbidities found in processing section (68.4%), followed by waste treatment plant (45.5%), ware house (44.4%), mill section (37.9%). These findings were discordant with findings of Masthi et al (2). The discrepancy may be due to variations in dust exposure levels at different work area and control measures adopted in different industrial settings.

Current study revealed that workers who were exposed to bagasse for > 8 hours were had more bagasse related morbidities. In this study, bagasse dust exposure was lower than in the previous studies conducted in South Africa (15), and Brazil (16). All of these studies showed high levels of bagasse dust intensity. The duration of exposure to bagasse dust is directly related to the length of working hours and area. Extended working hours increase the likelihood of adverse health effects due to prolonged and continuous exposure to harmful dust particles. High concentration of bagasse dust that can affect the nasal passages, causing an irritated and congested nose, and might also cause an irritant cough.

CONCLUSION

In the present study overall prevalence of bagasse dust related morbidities was found to be 29.2%. Among them maximum workers suffered from chronic cough (21.6%). Bagasse dust-related morbidities are more among those belonging to productive age group 31-40 (31.2%), Muslims (37.7%), married workers (29.4%), those educated up to intermediate (36.6%), and belonging to socioeconomic class III (37.4%). A significant association was seen with socioeconomic class. Significantly more prevalence of morbidities was seen in those working in processing areas (68.4%) and in those working for >8 hours/day (38.7%). But no significant association was observed with the working years of experience.

RECOMMENDATION

Respiratory problem being an important health issues among sugarcane factory workers, effecting. Present study emphasizes the need of appropriate preventive measures both at individual level and factory level. Few important preventive measures include use mask or respirator to protect form dust and chemical. Factories should maintain proper ventilation, dust suppression systems, and artificial humidification to control dust. There should be facilities to recycle bagasse for biofuel and 1% propionic acid should be used to prevent fungal growth. Preplacement examination and regular periodic examination of the workers should be emphasized. Regular training on use of PPE (gloves, goggles, masks/respirators, rubber boots, helmets, and ear protection) should be conducted.

LIMITATION OF THE STUDY

The only limitation was that we could not conduct Chest X ray and other respiratory examination to confirm bagassosis among those diagnosed with respiratory problems.

RELEVANCE OF THE STUDY

Investigating the working conditions of sugarcane factory workers is important due to their frequent exposure to serious occupational health risks, including respiratory problems from dust inhalation (bagassosis), musculoskeletal injuries from demanding physical labor, heat-related illnesses, and possible exposure to hazardous chemicals. Therefore, it is essential to comprehend and tackle these dangers to safeguard their health and well-being. Research can pinpoint opportunities for enhancing workplace safety and procedures within the sugarcane sector.

AUTHORS CONTRIBUTION

All authors have contributed equally in study design and data analysis.

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Nil

CONFLICT OF INTEREST

There are no conflicts of interest.

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DECLARATION OF GENERATIVE AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors haven't used any generative AI/AI assisted technologies in the writing process.

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