

## Burden of Occupational Morbidities and Their Determinants among Sugarcane Factory Workers: A Cross-Sectional Study

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### ABSTRACT

**Background:** Rapid industrial expansion has increased occupational health challenges, particularly in sugarcane workers facing multiple workplace related health challenges. Due to bagasse exposure respiratory problems like COPD and asthma are common. Other health issues are musculoskeletal disorders, skin irritations, heat stress, dehydration and mental health issues due to long working hours and increased exposure. In 2016, 1.88 million deaths and 89.72 million disability-adjusted life years (DALYs) were attributed by occupational hazards. Aim of this study to find out prevalence of various morbidities among sugarcane factory workers and their associated factors. **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:** Among 343 sugarcane workers, common morbidities included noise-related problems (36.4%), communication difficulty (21.3%), tinnitus (7.9%) and hearing loss (7.3%). Bagasse dust-related morbidity was seen in 29.2% workers. Other issues faced were chronic cough (21.6%), heat-related problems (17.5%), recurrent infections (13.1%), musculoskeletal disorders and mental health problems (10.8% each), dehydration (10.5%) and injuries (5.8%). Morbidities were significantly associated with work area and longer working hours. Noise and dust problems were more common in workers with <2 years' experience, while longer tenure showed increased musculoskeletal and mental health problems. **Conclusion:** Occupational hazards adversely affect workers' health, safety and organizational efficiency, it is preventable through regular training and adoption of proper safety measures.

### KEYWORDS

Determinants, Sugarcane factory, Occupational health problems, Morbidities.

### INTRODUCTION

Rapid industrialization and globalization have aggravated occupational health challenges, with workplace hazards compromising worker safety, well-being, and productivity.(1) Sugarcane workers are exposed to multiple risks leading to significant physical and mental morbidities. Dust and airborne particles cause respiratory illnesses with reduced lung function, strenuous and repetitive work results in musculoskeletal disorders. Exposure to plant sap, agrochemicals, and extreme heat leads to skin conditions, toxicity, heat stress, and dehydration. Prolonged labour/long working hours, and socio-economic stressors contribute to mental health problems. Globally, occupational risk factors caused 1.88 million deaths and 89.72 million DALYs in 2016, largely due to occupational diseases.( 2,3 )

In 2016, long working hours (≥55 hrs/week) caused 745,000 occupational deaths globally, followed by exposure to particulate matter, gases, and fumes (450,000) and injuries (363,000). Injuries accounted for

the highest DALYs (26.4 million), with long working hours (23.3 million) and ergonomic risks (12.3 million) ranking next.(4 ) Reducing these morbidities requires protective measures, regular health surveillance, and improved working conditions for sugarcane workers. This study aims to assess the prevalence of occupational morbidities and its associated factors among sugarcane factory workers.

### MATERIAL & METHODS

This cross-sectional study was conducted for a period of one year among workers of Government Sugarcane factory. The list of all sugarcane factories was obtained and one factory was selected randomly i.e. Kisan Co-op Sugar Factory, Sarsawa, Saharanpur, Uttar Pradesh. Study was conducted among all eligible workers (all male and female workers, including general, technical, administrative, and managerial staff etc) fulfilling the inclusion criteria and gave consent were included. Workers who showed hostile behaviour, disabled and

had low intellectual level, suffering from life threatening chronic illnesses were excluded. Total 400 workers were at the factory, 343 were interviewed based on inclusion and exclusion criteria. The remaining 57 were excluded: 27 did not consent, 3 had low intellectual ability, 11 were disabled or had chronic illnesses, and 16 provided incomplete information or were absent. Written permission was obtained from factory management, and data were collected across all shifts using a pretested semi-structured questionnaire. Written informed consent was taken, confidentiality ensured, and contact details provided for queries. The questionnaire covered sociodemographic details, work section, daily working hours, years of experience, and morbidities related to bagasse, noise, heat, infections, injuries, musculoskeletal, and mental health issues. Data collected was entered and analysed 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  $\leq 0.05$  was the cut off point for statistical significance. The study protocol was approved by the institutional ethical committee.

## RESULTS

Out of 343 workers included in the study 99.7% were males and 0.3% females. Maximum number of workers were found in the age group of 31-40 years (32.7%), followed by 18-30 years (28.5%), 41-50 years (23%), 51-60 years (12.5%), and >60 years (3.3%). The mean age of workers was 38.81 ( $\pm 11.36$  SD) years.

On analysing the prevalence of various morbidities among sugarcane factory workers, Noise related morbidities were most common accounting 36.4% followed by, bagasse dust related morbidities 29.2% and heat related morbidities 17.5%, infections (13.1%) (mainly skin infections among 7.3% workers), musculoskeletal disorders (10.8%), mental health issues (10.8%) and physical injuries (5.8%), Among noise related

morbidities every 5<sup>th</sup> worker faced difficulty in communication (21.3%) whereas dehydration (10.5%) was most common among health-related morbidities. Workers suffering from bagasse dust morbidities, chronic cough (21.6%) was most common symptom. (table 1)

Morbidities varied by working area, in boiler section majority had heat related morbidities (80%) followed by mental health issues (60%), noise related morbidities & recurrent infections 40% respectively. In cane receiving/uploading section noise related morbidities were found 33.3%. In supervisory staff most of the workers had mental health issues 25% and in mill section more than half of the workers found noise related morbidities 51.7%. Among lab/security/plumbing/drivers mainly MSDs 12.1% were observed. In power plant section physical injuries 33.3% were more common. In processing section all the workers were exposed to noise 100%, bagasse dust 68.4%, heat 47.4% respectively. While in warehouse section more than half were had noise induced morbidity 55.6%. In waste treatment section mainly, workers were affected by bagasse dust (45.5%). Differences were statistically significant ( $p < 0.05$ ). (Table 2)

Morbidities increase with longer working hours. Workers >8 hours/day had the highest rates of heat related morbidity (74.2%) and noise related morbidity (61.3%). Those working <6 hours/day mainly had noise related morbidity (41.1%) and physical injuries were only (1.3%). Workers with 6–8 hours/day showed lower prevalence overall, with noise and MSDs (15.9%). These Differences were found statistically significant ( $p < 0.05$ ). (Table 3)

Workers with <2 years had highest noise related morbidity (39.7%). Those with 3–5 years had lower prevalence overall. Workers with 6–10 years mainly had bagasse dust (39.7%) and noise (32.4%), while those >10 years showed higher MSDs (17.2%), mental health (16.4%), and injuries (12.9%). Differences in MSDs, injuries, and mental health morbidities were statistically significant ( $p < 0.05$ ). (Table 4)

**Table 1: Prevalence of various morbidities in sugarcane factory workers (N=343).**

Parameters	Morbidities	Present		Absent	
		No.	%	No.	%
Noise related morbidities	Difficulty in communication	73	21.3	270	78.7
	Difficulty in Communication with tinnitus	27	7.9	316	92.1
	Difficulty in communication with hearing loss	25	7.3	318	92.7
Total		125	36.4	218	63.6
Heat related morbidities	Problems due to dehydration (heaviness / sweating / Dizziness / fainting)	36	10.5	307	89.5
	Skin problems (dryness / itching / burning sensation)	06	1.7	337	98.3
	Problems due to dehydration with skin problem	18	5.2	325	94.8
Total		60	17.5	283	82.5
Bagasse dust related morbidities	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
	Chronic low back pain	15	4.4	328	95.6
	Chronic body pain	11	3.2	332	96.8

Work-related musculoskeletal disorders	Chronic low back pain with chronic body pain	11	3.2	332	96.8
Total		37	10.8	306	89.2
Physical injuries	Ocular injury	04	0.9	340	99.1
	Body injury	15	4.4	328	95.6
	Bone fracture	01	0.3	342	99.7
Total		20	5.8	323	94.2
Infections	Gastroenteritis	11	3.2	332	96.8
	Recurrent fever	05	1.5	338	98.5
	Skin diseases	25	7.3	318	92.7
	Skin diseases with gastroenteritis	04	1.2	339	98.8
Total		45	13.1	298	86.9
Mental health related morbidities	Anxiety / depression	03	0.9	341	98.1
	Stress	25	7.3	318	92.7
	Sleep disturbance	09	2.6	334	97.3
Total		37	10.8	306	89.2

**Table 2: Association of various morbidities among sugarcane factoryworkers with type of work area (N=343)**

Work area/ morbidities	Noise related morbidities	Heat related morbidities	Bagasse related morbidities	WMSDs	Physical injuries	Recurrent infections	Mental health related morbidities
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Boiler (n=20)	08 (40.0)	16 (80.0)	01 (5.0)	0 (0.0)	0 (0.0)	08 (40.0)	12 (60.0)
Cane receiving /uploading section(n=18)	06 (33.3)	0 (0.0)	02 (11.1)	02 (11.1)	0 (0.0)	02 (11.1)	03 (16.7)
Supervisor (n=08)	0 (0.0)	0 (0.0)	01 (12.5)	0 (0.0)	0 (0.0)	0 (0.0)	02 (25.0)
Mill section (n=145)	75 (51.7)	18 (12.4)	55 (37.9)	19 (13.1)	06 (4.1)	17 (11.7)	16 (11.0)
Other (lab, security, plumber, driver etc) (n=66)	01 (1.5)	07 (10.6)	06 (9.1)	08 (12.1)	02 (3.0)	07 (10.6)	03 (4.5)
Power generation plant (n=27)	0 (0.0)	04 (14.8)	04 (14.8)	04 (14.8)	09 (33.3)	02 (7.4)	0 (0.0)
Processing (dilution, chemical areas, clarification) (n=19)	19 (100.0)	09 (47.4)	13 (68.4)	0 (0.0)	03 (15.8)	04 (21.1)	0 (0.0)
Ware house(n=18)	10 (55.6)	04 (22.2)	08 (44.4)	0 (0.0)	0 (0.0)	03 (16.7)	01 (5.6)
Waste treatment plant(n=22)	06 (27.3)	02 (9.1)	10 (45.5)	04 (18.2)	0 (0.0)	02 (9.1)	0 (0.0)
Total(n=343)	125 (36.4%)	60 (17.5)	100 (29.2)	37 (10.8)	20 (5.8)	45 (13.1)	37 (10.8)
Chi square	106.408	77.655	49.570	9.496	26.539	12.980	64.074
df	8	8	8	8	8	8	8
P value	0.001	0.001	0.001	0.237	0.001	0.078	0.001

**Table 3: Association of various morbidities among sugarcane factory workers with working hours in the factory (N=343)**

Working hours / morbidities	Noise related morbidities	Heat related morbidities	Bagasse dust related morbidities	Work related Musculo-skeletal disorders	Physical injuries	Recurrent infections	Mental health related morbidities
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)

<6hours(n=224)	92(41.1)	33(14.7)	81(36.2)	16(7.1)	03(1.3)	28(12.5)	26(11.6)
6-8 hours(n=88)	14(15.9)	04(4.5)	07(8.0)	14(15.9)	13(14.8)	04(4.5)	09(10.2)
>8 hours(n=31)	19(61.3)	23(74.2)	12(38.7)	07(22.6)	04(12.9)	13(41.9)	02(6.5)
Total (343)	125(36.4)	60(17.5)	100(29.2)	37(10.8)	20(5.8)	45(13.1)	37(10.8)
Chi square	24.354	80.458	24.842	9.971	26.740	22.926	0.533
df	2	2	2	2	2	2	2
P value	0.002	0.001	0.001	0.007	0.001	0.001	0.765

**Table 4: Association of various morbidities among sugarcane factory workers with years of working experience (N=343)**

Years of work experience / Morbidities	Noise related morbidities No. (%)	Heat related morbidities No. (%)	Bagasse dust related morbidities No. (%)	Work related musculoskeletal disorders No. (%)	Physical injuries No. (%)	Recurrent infections No. (%)	Mental health related morbidities No. (%)
<2 years(n=78)	31(39.7)	18(23.1)	19(24.4)	03(3.8)	02(2.6)	10(12.8)	11(14.1)
3-5 years(n=81)	32(39.5)	08(9.9)	25(30.9)	09(11.1)	0(0.0)	13(16.0)	02(2.5)
6-10 years(n=68)	22(32.4)	11(16.2)	27(39.7)	05(7.4)	03(4.4)	13(19.1)	05(7.4)
>10 years(n=116)	40(34.5)	23(19.8)	29(25.0)	20(17.2)	15(12.9)	09(7.8)	19(16.4)
Total(n=343)	125(36.4)	60(17.5)	100(29.2)	37(10.8)	20(5.8)	45(13.1)	37(10.8)
Chi square	1.344	5.465	5.320	9.556	12.695	5.905	12.236
df	3	3	3	3	3	3	3
P value	(0.722)	(0.141)	(0.798)	(0.021)	(0.001)	(0.110)	(0.006)

## DISCUSSION

Noise-related morbidities were 74.6% exposed to noise, highest noise exposure were in mill section followed by processing section, ware house and boiler section. While the previous study done by Nayakawadi et al. (2014) <sup>5</sup> observed highest noise levels in power turbine, sugar house, and boiler. Workers in these sections at greater risk of noise-related morbidities. Prolonged loud noise exposure can cause tinnitus, hearing loss, impair communication and concentration, affecting workers' quality of life and performance. To reduce effect of noise exposure factories should adopt the preventive measures such as noise aids, PPE and rotation in the shift including limited working hours.

In present study 17.5% workers were exposed to heat, common complaints including dehydration symptoms such as heavy sweating, dizziness, or fainting (10.5%), skin problems (1.7%), and combined dehydration with skin issues (5.2%).

Similar study done by Debela et al. (2023) <sup>6</sup> found 72.4% exposure, with severe thirst and dry mouth most common. Kiatkitroj et al. (2021) <sup>7</sup> reported 48% prevalence with symptoms such as heavy sweating, fatigue, dizziness, cramps, and headache; while Boonruksa et al. (2020)(8) noted severe perspiration and weakness as predominant complaints; and Taffere et al. (2017)(9) reported excessive heat exposure in 75.7% of workers. Overall, these findings indicate a higher burden of heat-related illness compared to current study, may be variety of workers including in the study. Prolonged exposure to heat overwhelms thermoregulation, elevates core body temperature, and causes adverse health effects in sugarcane workers. so factories should adopt

safety measures like PPE, proper ventilation and exhaust system including water asses near of working place etc.

In the present study, Bagasse dust exposure in 29.2% workers, highest in workers working in the processing section (68.4%), followed by waste treatment (45.5%), warehouse (44.4%), and mill sections (37.9%), differing from Nayakawadi et al. (2014) <sup>10</sup>. Overall, 85.4% of workers were exposed to bagasse dust, particularly for 4–8 hours/day, though exposure levels were lower than studies from South Africa(11), Indonesia(12), and Brazil(13). Respiratory morbidities included chronic cough (21.6%), phlegm (1.5%), breathlessness (1.2%), wheeze (0.9%), and combined symptoms. Debela et al. (2023)(14) reported much higher exposure (85.5%) and respiratory symptoms (60.6%). Prolonged working hours and high dust concentrations increase respiratory irritation, congestion, and cough due to bagasse dust exposure. Safety measures should be taken by factories like provide PPE with mask, dust fogging, maintain ventilation and reduce working in bagasse prone area by shift rotation.

In this study, chronic low back pain (4.4%) and body pain (3.2%) were reported, comparable to Jayer et al. (2023) <sup>15</sup> but lower than reports by Mohamed et al. (2017)(16) and Bisht et al. (2016) <sup>17</sup>. WRMSDs increased with longer work experience, particularly >10 years, aligning with findings by Pawar et al. (2019) <sup>18</sup> and Babatunde et al. (2023) <sup>12</sup>, likely due to prolonged heavy lifting, poor posture, and repetitive tasks in sugarcane factory work. This can be minimised by avoid long standing, using machinery for heavy loading and break between the shifts.

Handling heavy machinery and sugarcane exposes workers to physical injuries and skin conditions. In the present study, 4.4% had body injuries, 0.9% ocular injuries, and 0.3% fractures. Similar findings were reported by Jasani *et al.* (2017)(19) mainly minor injuries were found, whereas Mohamed *et al.* (2017)(20) reported much higher rates of lacerations, burns, wounds, and sprains, indicating variability in injury burden across settings. This can be prevented by the using safety measures like using PPE including rubber gloves & shoes, Helmets and face shield and job rotation of workers etc.

Sugarcane workers are exposed to chemicals, sap, and dust, predisposing them to skin and other infections. In the present study, work-related infections affected 13.1% of workers, including skin diseases such as fungal infections and dermatitis (8.5%), gastroenteritis (4.7%), and recurrent fever (1.5%). Higher prevalence was reported by Bisht *et al.* (2016)<sup>21</sup>, Bhuniyan *et al.* (2016)<sup>21</sup>, and Mohamed *et al.* (2017)(20), indicating greater infection burden in other settings. These symptoms can be minimised by adopting personal protective measures like PPE (Rubber gloves& shoes), maintain hygiene at workplace or consult a doctor.

In the present study, mental health morbidities higher prevalence was observed in the boiler section (60%), supervisory staff (25%), and workers with >10 years of experience (19%). Reported problems included stress (7.3%), anxiety/depression (0.9%), and sleep disturbances (2.6%). Similar associations between longer working hours and mental illness were reported by Bazo-Alvarez *et al.* (2022)<sup>22</sup>, while Costa *et al.* (2017)(23) reported a much higher prevalence (40%) among sugarcane workers. Shorter working hours (<6 hours/day) appeared protective for mental health and quality of life. This can be reduced by giving breaks in between shifts, job rotation and create recreational activities at workplace to increase harmony between workers.

Overall burden of comorbidities in current study was 30.9%, with hypertension (23.9%) and diabetes (3.2%) being most common. Similar hypertension prevalence was reported by Bisht *et al.* (2016)<sup>21</sup>. Obesity (36.2%) and overweight (32.1%) were also common, comparable to findings by Khot *et al.* (2024)<sup>24</sup>, Masthi *et al.* (2018)(25), and Khade *et al.* (2018)<sup>26</sup>. These patterns may be attributed to poor dietary habits, substance use, and physical inactivity. These are associated with the life style, so focus on the life style modification and create awareness for early treatment to prevent complication.

## CONCLUSION

Occupational morbidities were significantly associated with sociodemographic factors, work area, working hours, experience, and exposure intensity. Higher risk of morbidities was observed in boiler, processing, and mill sections. Long working hours, more years of working experience led to prolonged exposure to noise, heat, and bagasse dust highlighting cumulative exposure as the key determinant.

## RECOMMENDATION

Implementation of pre-placement and periodic health examinations, ensure on-site first aid and proper PPE use.

Reduce hazards through ventilation, dust control, cooling measures, noise protection, regular breaks, and job rotation. Strengthen safety training and ergonomic practices and promote recreational activities at the workplace.

## AUTHORS CONTRIBUTION

All authors have contributed equally.

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## CONFLICT OF INTEREST

There are no conflicts of interest.

## 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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