Morbidities of rice mill workers and associated factors in a block of West Bengal: A matter of concern

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Abstract

Context: Rice mill workers usually belong to unorganized sector and lack in training regarding hazard prevention. Unprotected exposure to suspended particles and fumes can lead to respiratory morbidities among them. Workers, especially loaders, were susceptible to work-related musculoskeletal diseases. **Aim:** To find out the morbidity profile and associated factors among rice mill workers. **Methodology:** A cross-sectional workplace-based study was conducted during July--September 2018 among 143 workers of two rice mills in Indas block, West Bengal. Workers, employed for at least 6 months in the rice mills and who gave informed written consent was interviewed using a predesigned pretested questionnaire and were clinically examined. Nonfasting capillary blood glucose estimation and spirometry were carried out. Workers contraindicated to spirometry were excluded. **Result:** Commonest morbidities were musculoskeletal discomfort (65%), hypertension (20.9%), and chronic respiratory morbidity (16.9%). No personal protective equipment (PPE) was used by these workers. Significant association of musculoskeletal discomfort was found with tobacco abuse (Adjusted Odds Ratio (AOR) =2.90), job of loader (AOR = 3.51), and central obesity (AOR = 3.39). Hypertension was significantly associated with increasing age (AOR = 1.06), and increasing body mass index (AOR = 1.17). Whereas increasing age (AOR = 1.08), working inside mill (AOR = 7.58), working more than 48 hours a week (AOR = 7.37) were significantly associated with chronic respiratory morbidity. **Conclusion:** Optimization of working hours, effective continuous use of PPE, and use of proper ventilation technology are recommended. Proper work placement, preplacement examination, and periodic health screening with spirometry are also needed.

Keywords: Chronic respiratory, hypertension, morbidity, musculoskeletal, occupational diseases, rice mill

Introduction

India is the second largest rice producing country in world.[1] More than one lakh mills processing raw (white) and parboiled rice are running in India.[2] Processing of rice has several steps. After harvesting, paddy is threshed and sent to mills. In the mill, paddy is cleaned, parboiled (in case of white rice, parboiling is avoided), dried, and hulled. Then, bran is sorted and rice is polished, sorted for quality, and sent for sale. Air pollution is high in mills especially during cleaning, parboiling, and hulling.[3] Exposure to fungal spores containing aflatoxin in improperly stored paddy can potentiate the inflammatory reaction in lungs.[4] Moreover, rice husk contains high percentage of silica which itself is detrimental to human lungs. In mills, this husk is either blown using blower or burnt as a fuel for boiler. The boiler generates fly ash, suspended particulate matter (SPM), smoke, and oxides of carbon. The longstanding irritation caused by these organic and inorganic dust results in mucosal hypertrophy leading to chronic respiratory diseases as well as other occupational diseases like pulmonary fibrosis, pleural thickening, and bronchogenic carcinoma.[3] Lifting and carrying heavy sacks is the major job component in a rice mill. Often, due to lack of skills

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the workers have to adopt inappropriate work postures leading to musculoskeletal problems and workplace injuries.[5]

Bankura is one of the largest paddy producing districts in West Bengal and has 83 rice mills. Indas block in Bankura district has 12 rice mills which are currently operating.[6]

Very few studies are available in India on rice mill workers and most of these available studies focus on respiratory morbidities only. Moreover, majority of the previous studies did not classify workers as per their job profile to elicit the association of occupational differentials with morbidity pattern. In this context, a cross-sectional study was conducted among workers from two of these 12 rice mills of Indas to find out the morbidity profile and its associated factors with in depth analysis of occupational differentials.

Materials and Methods

Study Design: A cross-sectional workplace-based study was done during July–September 2018 among workers employed in 2 rice mills of Indas block, West Bengal.

Inclusion and Exclusion Criteria: All types of workers who were employed in these mills and working for at least 6 months were included in the study. Workers who did not give informed written consent were excluded. Workers who had contraindication for spirometry, such as pregnancy, history of acute myocardial infarction, pulmonary embolism, or heart failure or in the previous 6 weeks had undergone abdominothoracic, head and neck, or cataract surgery were excluded from spirometry.[7]

Sample Size and Sampling Technique: In a previous study, prevalence of respiratory morbidity among rice mill workers was 40.73%.[8] Now taking standard normal deviate Z = 1.96 (for 95% confidence interval) and 20% relative error (d) minimum sample size was Z^2x p x (1-p)/(p x d) ^{2} = 139.7 = 140. Out of the total 147 workers who were included in the study 143 workers actually participated (response rate = 97.3%). One worker was excluded from spirometry due to history of valvular operation in recent past. Thus, 142 participants undertook spirometry.

Study tools

A. Pretested predesigned schedule in the local language with the following domains:
1. Sociodemographic characteristics {age, gender, religion, caste, marital status, type of family, education, socioeconomic status (modified BG Prasad scale), Per Capita Income (PCI)}
2. Behavioral characteristics: {addiction, occupational physical activity [adapted from Occupational Physical Activity Questionnaire}.[9]
3. Occupational differentials {type of job, work inside mill or not, work experience, work hours/week, use of personal protective equipment (PPE), self-perceived heavy work, self-perceived workplace discomfort}
4. Morbidity Profile

- Musculoskeletal morbidity {using Cornell Musculoskeletal Discomfort Questionnaire (CMDQ)},[10,11]
- Respiratory morbidity (result of spirometry)
- Diabetes [result of capillary blood glucose (CBG) estimation]
- Hypertension (result of blood pressure (BP) measurement)
- Nutritional status (result of anthropometry)
- Other morbidities

B. Aneroid sphygmomanometer
C. Stethoscope
D. Portable calibrated adult weighing machine
E. Nonstretchable measuring tape
F. Autocalibrated PC-based spirometer (RMS HELIOS 401™)
G. Glucometer

Data collection: This study was approved by Institutional Ethics Committee of All India Institute of Hygiene and Public Health, Kolkata (15/11/2017). After getting permission of owners camps were organized in those mills. Informed written consent was obtained and workers were interviewed with help of a predesigned pretested structured questionnaire. After which they were examined clinically, BP was measured and anthropometric measurement was conducted as per standard operating procedures.[12]

Spirometric examination was carried out in sitting posture as per standard method.[13] Ethnic correction using Indian predicted equation and temperature correction were done by software provided with spirometer. Values of forced vital capacity (FVC, % of predicted value), forced expiratory volume in 1st second (FEV_1, % of predicted value), FVC/FEV_1, and peak exploratory flow rate (PEFR) were noted. Nonfasting CBG estimation was done aseptically. All biomedical wastes were taken care of according to standard norms.[12]

Operational definitions

Chronic respiratory morbidity was defined as abnormal spirometric value according to standard guideline.[13]

- Obstructive disease was defined as FEV_1/FVC <0.7.
- Restrictive disease was defined as FEV_1/FVC ratio ≥0.7 and FVC <80% predicted.
- Mixed pattern was denoted if there was FEV_1/FVC < 0.7 and FVC <80% predicted.
- FEV_1 ≥80% predicted was noted as mild; FEV_1 in between 50% to 80% predicted was termed as moderate and FEV_1 <50% predicted value was interpreted as severe respiratory disease.

Musculoskeletal morbidity was defined as attainment of lowest positive score (≥ 1.5) in CMDQ questionnaire.

Central obesity was defined as presence of waist circumference >90 cm in male and >80 cm in female participants.

Hypertension was defined as Systolic blood pressure (SBP) ≥140 mm of Hg or Diastolic blood pressure (DBP) ≥90 mm of Hg or history of hypertensive medication use.

Diabetes/high blood sugar was denoted as nonfasting CBG ≥160 mg/dl or history of diabetes medication use.

Current smoker was denoted as persons who were smoking currently and smoked at least 100 cigarettes/bidis in life time.

Data analysis: All data were compiled and analyzed using MS Excel 2013 and Statistical Package for the Social Sciences version 16 (SPSS for Windows, version 16.0, SPSS Inc., Chicago, USA). Descriptive and inferential statistics including univariate and multivariable logistic regression were calculated. P value < 0.2 in univariate model was used as selection criteria for a biologically plausible variable in multivariable model where P value < 0.05 was considered as level of significance.

Result

Most of the workers were males (95.1%), Hindus (97.2%), Married (82.5%), and belonged to joint family (65.7%). Almost two-third (65.0%) was current smokers. Three-fourth of the study subjects (75.5%) used any form of tobacco. Nearly, half (41.3%) of them were consuming alcohol. Multiple addictions were present among 39.9% subjects. Majority of them (60.1%) worked predominantly inside the mill. Their occupational profile is shown in Figure 1. Less than half (43.4%) wrapped cloth over their mouth and nostril to prevent dust inhalation while working. No other PPE was used by them.

Other background characteristics and occupational differentials are shown in Table 1. About 23.1% complained about dust and improper ventilation and 21% complained about uncomfortable temperature in workplace. 17.1% workers received injury during work in their lifetime. Only one needed hospitalization. No one faced any disability due to injury. Cut was the commonest type of injury (32.0%) followed by muscle sprain (28.0%) and blunt trauma (20.0%). Injuries were more common among loaders (52.0%). 69.2% was suffering from any kind of morbidity. Commonest morbidities were musculoskeletal morbidity (65%), hypertension (21%), and chronic respiratory morbidity (16.9%). Their morbidity profile is demonstrated in Figure 2. Nutritional status as measured by body mass index (BMI) revealed presence of underweight (18.2%) and overweight (20.3%) among whom 3.5% were obese. Central obesity was present in 37.8% subjects. 14.7% had pallor. Mean PEFR (SD) was 4.92 (1.68) liter/second. 11.3% showed obstructive, and 4.9% showed restrictive pattern in spirometry. One (0.7%) subject had mixed pattern of respiratory morbidity. Among all the subjects having obstructive lung disease (including mixed pattern) 64.7% had mild, 29.4% moderate, and 5% had severe disease.

Table 2 In univariate regression among several independent variables increasing age (OR = 1.06, P value = 0.001), working inside mill (OR = 5.71, P value = 0.007), working > 48 hours per week (OR = 8.67, P value = 0.005) were found significantly associated with chronic respiratory morbidity. Current smoker had 1.98 times higher odds to have chronic respiratory morbidity than nonsmokers (P value = 0.16). These four variables were included in final multivariable model. Odds of smoking status was attenuated (AOR = 1.10, P value = 0.87). Work duration was also attenuated but remained significant (AOR = 7.37, P value = 0.013). OR of working inside the mill (AOR = 7.58, P value = 0.006) and increasing age (AOR = 1.08, P value = 0.001) were increased. This model fit was good as Hosmer--Lameshow test showed insignificant value and 21.9% to 36.7% variability of dependent variable was explained by the model as revealed by Cox and Snell and Nagelkerke R^2, respectively.

Table 3. Majority (65.0%) felt musculoskeletal discomfort in last week among which 23.9% had pain in multiple zones. Loaders felt more discomfort comparison to others (44.6%). Back was the commonest site for most of work groups except for the machine men and loaders. Commonest area of discomfort among loaders was lower extremity (31.7%), followed by back (19.5%). Significant association of musculoskeletal discomfort was found with addiction to tobacco (OR = 2.82, P value = 0.009), job of loading and unloading (OR = 2.49, P value = 0.012), and central obesity (OR = 2.35, P value = 0.026). Duration of job was also included in final multivariable model (OR = 1.05, P value = 0.108). Adjusted model showed augmentation of OR in all four variables. This model was fitting well as

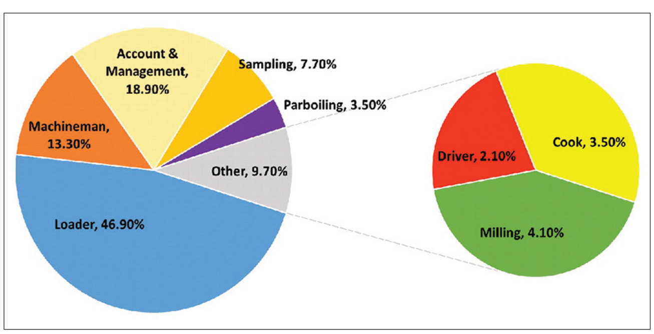

Figure 1: Occupational profile of study subjects (N = 143)

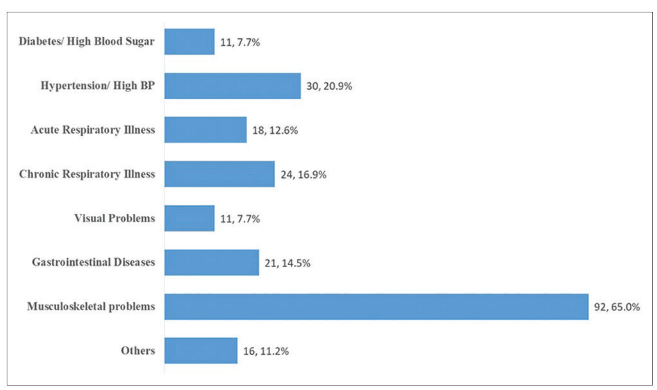

Figure 2: Proportion of different morbidities among study subjects

Table 1: Sociodemographic and occupational characteristics of study subjects (*n*=143)

Characteristics		Number (%)	Descriptive statistics
Age (in completed years)	≤ 20	10 (7.0)	Mean (SD) = 35.7 (12.6) Range=64
	21-30	56 (39.2)	
	31-40	32 (22.4)	
	> 40	45 (31.4)	
Caste	SC	66 (46.1)	
	ST	4 (2.8)	
	OBC	6 (4.2)	
	Other	67 (46.9)	
Education category	No formal education	22 (15.4)	
	Primary	35 (24.5)	
	Middle	35 (24.5)	
	Secondary	16 (11.1)	
	≥ Higher secondary	35 (24.5)	
Socioeconomic class (modified BG Prasad Scale 2018) in PCI (Rs)	Class I (≥6574)	3 (2.1)	Median PCI (IQR) = 1000.0 (714.2,1666.7) Range=22070.7
	Class II (3287-6573)	3 (2.1)	
	Class III (1972-3286)	16 (11.2)	
	Class IV (986-1971)	66 (46.2)	
	Class V (≤ 985)	55 (38.5)	
Heavy work (self- perceived)	Yes	68 (47.6)	
	No	75 (52.4)	
Working hour/week	< 48 Hours	55 (38.5)	Mean (SD) = 57.6 (13.9) Range=84
	48 To 60 Hours	45 (31.4)	
	> 60 Hours	43 (30.1)	
Duration of job (in years)	< 5 year	73 (51.0)	Median (IQR) = 4 (3,9) Range=34.5
	5-9 years	36 (25.2)	
	≥10 years	34 (23.8)	

Table 2: Predictors of chronic respiratory morbidity: Univariate and multi-variable logistic regression (*n*=142)

Characteristics *	Total (*n*)	Chronic respiratory morbidity Number (%)	OR (95% CI)	AOR (95% CI)	*P*
Work inside mill					
Yes	86	21 (24.4)	5.71 (1.61,20.18)	7.58 (1.81,31.83)	0.006
No	56	3 (5.4)	1	1	
Work duration					
> 48 hour/week	88	22 (25.0)	8.67 (1.95,38.55)	7.37 (1.51,35.87)	0.013
≤ 48 hour/week	54	2 (3.7)	1	1	
Smoking status					
Current smoker	82	17 (20.7)	1.98 (0.76-5.13)	1.10 (0.35-3.48)	0.87
Others	60	7 (11.6)	1	1	
Age (↑)	-	-	1.06 (1.02-1.10)	1.08 (1.03-1.13)	0.001

* Model is adjusted with other socio-demographic and occupational and health related variables. Model fitting is good (omnibus test *P* value<0.0001, Hosmer-Lemeshow test *P* value=0.088, Cox & Snell R^2=0.219, Nagelkerke R^2=0.367)

Table 3: Predictors of musculoskeletal morbidity: Univariate and multi-variable logistic regression (*n*=143)

Characteristics*	Total (*n*)	Musculoskeletal morbidity number (%)	OR (95% CI)	AOR (95% CI)	*P*
Tobacco abuse (in any form)					
Yes	108	76 (70.4)	2.82 (1.29,6.18)	2.90 (1.22,6.91)	0.016
No	35	16 (45.7)	1	1	
Central obesity					
Present	54	41 (75.9)	2.35 (1.11,4.98)	3.51 (1.48,8.33)	0.004
Absent	89	51 (57.3)	1	1	
Type of work					
Loader	68	51 (75.0)	2.49 (1.22, 5.07)	3.39 (1.51,7.63)	0.003
Other	75	41 (54.7)	1	1	
Job duration (in years) (↑)	-	-	1.05 (0.99,1.11)	1.06 (0.99,1.13)	0.078

* Model is adjusted with other sociodemographic, behavioral, occupational, and health-related variables. Model fitting is good (omnibus test *P* value<0.0001, Hosmer-Lemeshow test *P* value=0.534, Cox & Snell R^2=0.162, Nagelkerke R^2=0.222)

Hosmer--Lameshow test revealed insignificant result and 16.2% to 22.2% variability of dependent variable was explained by this model by Cox and Snell and Nagelkerke R^2.

Table 4 Workers with jobs related to accounts and management were more hypertensive (37.0%) compared to others (OR = 2.226, *P* value = 0.085). Hypertension were significantly associated with increasing Age (OR = 1.08, *P* value < 0.001), BMI (OR = 1.15, *P* value = 0.01), and increasing years of smoking (OR = 1.06, *P* value = 0.017), presence of central obesity (OR = 3.21, *P* value = 0.006), and chronic respiratory morbidity (OR = 2.94, *P* value = 0.027). Central obesity was excluded in multivariable model due to high correlation with BMI (Spearman Rho = 0.73). Both age and year of smoking were included in final model due to poor correlation between them (Spearman Rho = 0.12). In adjusted model OR of job related to accounts and management (AOR = 0.93, *P* value = 0.90), years of smoking (AOR = 1.05, *P* value = 0.080), and chronic respiratory morbidity (AOR = 2.27, *P* value = 0.164) were attenuated. OR of increasing age (AOR = 1.06, *P* value = 0.010) and BMI (AOR = 1.17, *P* value = 0.017) were flattened but remain significant. This model was fitting well as Hosmer--Lameshow test revealed insignificant result and 17.9% to 28.1% variability of dependent variable was explained by this model by Cox and Snell and Nagelkerke R^2, respectively.

Discussion

A study by Prakash *et al.* at Tumkur in 2006 revealed prevalence of respiratory morbidity was highest (42.6%) followed by musculoskeletal (20%), conjunctivitis (6.8%), and skin allergy (4%). 10.6% of workers had low PEFR (<200 lit/min).[14] Rana *et al.* found the prevalence of respiratory morbidity at Burdwan in 2016 was 40.73% in which obstructive and restrictive disease were 24.60% and 16.13%, respectively. Higher risk of respiratory morbidity was noted if no protective measures used and working ≥9 hours/day but no association was seen with other.[8] Ghosh *et al.* found in 2008 that workers exposed to dust were presented with significant lower level of FVC, FEV_1, and PEFR parameters compared to control in Karnataka.[15] Vijayashankar *et al.* showed PEFR (5.65 ± 1.84) in rice mill workers in Mysore district was significantly lower than unexposed controls (8.11 ± 1.41) and decrease of PEFR was inversely proportional to duration of exposure.[4] High prevalence of respiratory morbidity (34%) was also found among rice mill workers of Bangladesh by Ansari *et al.*[16] Koteswaramma *et al.* found significantly higher prevalence of respiratory morbidity among rice mill workers (74%) than control (26%) and respiratory morbidity was proportionately increasing with the duration of dust exposure. Respiratory symptoms were more in workers involved in sweeping and milling inside mill.[17] Present study showed lower prevalence of respiratory morbidity than other studies except Prakash *et al.* and Vijayashankar *et al.* This differential finding might be due to different sampling methods or younger population with less work duration and/or use of modern technology in studied mill. Due to lack of resources triangulation of spirometric findings with air quality monitoring inside mill could not be done. Significant association of chronic respiratory morbidity was noted with higher working hours and working inside mill. That corroborates with the findings of Rana *et al.*, Koteswaramma *et al.*, and Ghosh *et al.* Augmentation of OR of working inside mill was noted after introduction of smoking status in adjusted model which might be due to effect modification. However, this could not be confirmed statistically with stratified analysis since there were very few workers with chronic respiratory morbidity belonging to nonsmoker group.

Musculoskeletal distress was observed among 45.7% of the workers by Darbastwar *et al.* most of whom were coolies (70%) and helpers (19%). Common affected areas were low back (27.1%) and knee (25%). Musculoskeletal problem was significantly associated with duration of work.[5] Higher prevalence of musculoskeletal problems was found in the current study in comparison to the findings in the studies of Prakash *et al.* and Darbastwar *et al.* The most probable reason of this difference being the use of more sensitive tool (CMDQ) with minimum chance of recall bias (1 week of recall period) in this study. Unlike Darbastwar *et al.*, the association of musculoskeletal discomfort with duration of work was not significant (*P* value = 0.078). Rather musculoskeletal morbidity was found significantly associated with tobacco use. Tobacco

Table 4: Predictors of hypertension: Univariate and multivariable logistic regression (*n*=143)

Characteristics *	Total (*n*)	Hypertension number (%)	OR (95% CI)	AOR (95% CI)	*P*
Year of smoking					
(in years) (↑)	-	-	1.06 (1.01,1.10)	1.05 (0.99,1.10)	0.080
Age					
(in years) (↑)	-	-	1.08 (1.04,1.12)	1.06 (1.01,1.10)	0.010
Chronic respiratory morbidity					
Present	24	9 (37.5)	2.94 (1.13,7.65)	2.27 (0.72,7.23)	0.164
Absent	118	2 (16.9)	1	1	
Type of work					
Accounts/management	27	10 (37.0)	2.26 (0.89, 5.73)	0.93 (0.28,3.06)	0.900
Other	115	20 (17.4)	1	1	
BMI (kg/m²) (↑)	-	-	1.15 (1.03,1.29)	1.17 (1.03,1.33)	0.017

* Model is adjusted with other sociodemographic, behavioral, occupational, and health-related variables. Model fitting is good (omnibus test *P* value<0.0001, Hosmer-Lemeshow test *P* value=0.598, Cox & Snell R^2=0.179, Nagelkerke R^2=0.281)

abuse may not be cause but effect of discomfort as studies showed antinociceptive effects of nicotine.[18] The difference in site of musculoskeletal discomfort among various types of workers was probably due to difference of work pattern and duration of standing hours according to the nature of work. Present study showed higher prevalence of diabetes (7.7%) and hypertension (20.9%) among workers than that of rural population of West Bengal as per NFHS 4.[19] Hypertension was associated with proximate variables like increasing age, BMI, and Presence of chronic respiratory morbidity in the present study. Patil *et al.* observed higher BP among rice mill workers compared to control in a study in Raichur.[20] Kaur *et al.* found high prevalence of hypertension (27.2%) and diabetes (16.3%) in male factory workers in Chennai and hypertension was associated BMI, waist–hip ratio, and increasing age.[21] Prabhakaran *et al.* showed similar proportion of hypertension (30%) and diabetes (15%) among workers in Delhi.[22] Findings of those studies were concordant with our finding. Several studies across the globe also suggested a relationship of increased blood pressure and diabetes with high density of SPM.[23-28] some studies also demonstrated level of SPM inside rice mills are alarmingly higher than the recommended level.[29-31] Thus, longstanding exposure to SPM could be one of the important predictor of Non communicable diseases for these mill workers.

Though rice milling is one of the largest agro-based industries in India, most of the mills run as small to medium scale industry in unorganized sector and practically no training is meted out to the workers regarding prevention of exposure to hazards in their workplace. There is no provision of preplacement examination, periodic health screening, or health service.[32] Most of the workers have no health insurance coverage. Once sick mostly due to their unconducive working environment often they are out of work leading to poverty and more suffering. To fulfill this unmet need WHO has recommended integration of basic occupational health services (BOHS) with primary health care (PHC) settings which is basically a part of Alma Ata Declaration.[33] BOHS and PHC share some common values like holistic approach to health, health equity, accessible, and acceptable preventive and curative services to decrease burden of morbidities in a cost-effective approach. Thus, collaboration between these would enhance working life as well as economic prosperity for a country. PHC can be used for occupational health and hazard surveillance and provision of preventive and curative service to all workers including underserved groups who are from informal sector, agriculture, and migrant and contractual workers. Capacity building and awareness generation among employers as well as workers regarding identification and reduction of occupational hazards, warning signs of occupational diseases can also be carried out through this approach.[34,35]

Conclusion

In the present study, respiratory and musculoskeletal morbidities seemed to be a momentous problem among rice mill workers. Significant association of respiratory morbidity was found with dust exposure inside mill and increased work duration (>48 hours per week). Thus, optimization of working hours, effective, and continuous use of appropriate PPE like respirator, mask and use of appropriate ventilation technology should be made mandatory. Smoking inside mill should be prohibited. Moreover, periodic health screening with spirometry should be done among workers for early diagnosis and treatment of respiratory problems. This will play a long way in checking the onslaught of lung morbidity to the point of no return. Musculoskeletal morbidity was significantly associated with central obesity and job of loaders. Use of modern machinery for mechanized loading/unloading may be helpful. Proper placement after preplacement examination, training regarding ergonomically better posture, and frequent resting time are also needed. Prevalence of NCDs was quite high. Exhaustive and earnest health education regarding lifestyle modification for the prevention and control of NCD must advocate among these workers. Further research is required for generation of evidence-based intervention for promotion of health among workers. Also, all efforts must be made to provide these rice mill workers for a streamlined health care integrated to primary health care facilities so that comprehensive health care is meted out to them not only before and during employment but also after retirement.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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