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PREVALENCE OF RESPIRATORY PROBLEMS AND MUSCULOSKELETAL DISORDERS AMONG RICE MILL WORKERS IN KARNAL DISTRICT OF HARYANA

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Abstract

Rice mill workers constitute a special group from the perspective of occupational health. Unprotected dust exposure adversely affects their respiratory system which needs to be evaluated. Therefore, the aim of the present study is to find out the prevalence of respiratory problems and musculoskeletal disorders among the rice mill workers of Karnal district in Haryana. A sample of 155 rice mill workers has been taken through random sampling. Workers have been physically examined; lungs functioning tests performed and interviewed using a pre-designed schedule. The study shows that most of the rice mill workers have been suffering from blocked nose (76.77 per cent), phlegm (73.55 per cent) and morning sneezing (72.90 per cent). Among musculoskeletal complaints, weakness is common among 80.0 per cent workers followed by pain in shoulders (65.81 per cent) and back pain (56.13 per cent). Non-use of any protective measures and duration of working in rice mills have been significant predictors of respiratory problems and musculoskeletal disorders among workers. Hence, proper health care and provision of personal protective equipments is essential to reduce the health disorders among the rice mill workers.

Keywords: Health, Workers, Rice Mill, Lung Function, Karnal.

Introduction

Rice mill industry is the oldest and largest agro-based industry in India. There are about 30,000 rice mills in the country (Kachru, 2006). It is an important sector of employment for a large number of unskilled and semi-skilled workers and considered under less organized sector (Ansari et al., 2017). India processes about 85 million tons of rice per year (Dewangan and Patil, 2015). In rice mills, a large amount of organic and inorganic dust having high silica content is generated in the milling process (Dhillon et al., 2011). Rice dust is a heterogeneous complex mixture of components including insect fragments, fungi, animal dander, bird and rodent feces, mammalian debris, microorganisms, bacterial endotoxins, aflatoxins, pollen and certain chemical additives such as pesticides and herbicides (Patil et al., 2015; Eshwaramma et al., 2016). Rice mill workers are exposed to dust having

adverse effects on their respiratory health (Musa et al., 2000). This biogenic dust may cause pulmonary disease resembling asbestosis such as pleural thickening, fibrosis, and possibly bronchogenic carcinoma (Ghosh et al., 2014). Husk generated in rice mills is also a hazardous substance with respiratory sensitizing properties and may provoke asthma and chronic bronchitis (Desai and Ghosh, 2003). Chest congestion is a common problem among the rice mill workers (Musa et al., 2000). Rice dust can also act as an irritant and may give rise to chronic cough, sputum production, skin, nasal and eye problems (Ansari et al., 2017). Several cross-sectional epidemiological studies have shown a higher prevalence of respiratory problems among the workers working in rice mills (Ghosh et al., 2014; Sultana and Afrad, 2014; Dewangan and Patil, 2015; Tripathi et al., 2015; Darbastwar et al., 2016; Eshwaramma et al., 2016; Ansari et al., 2017; Vijayashankar and Rajeshwari, 2018; Rana et al., 2018).

Rice mill workers also face a lot of physical health problems due to lifting of heavy loads. The workers have to adopt awkward postures for lifting heavy load which leads to physiological strain and musculo-skeletal disorders among them (Pradhan et. al., 2007; Prakash et al., 2010; Darbastwar et al., 2016). Generally, indigenous and conventional technologies are used in rice mills in India, which are not oriented towards minimizing pollution including dust emission. In this context, this study has been carried out to find out the prevalence of respiratory problems and musculoskeletal disorders among rice mill workers of Karnal district of Haryana.

Objectives of the Study

The major objectives of the study are:

- to study the prevalence of respiratory problems and musculoskeletal disorders among rice mill workers of Karnal district and
- to study the relationship between duration of work and occupational health among rice mill workers.

Study Area

Karnal district is located between 29° 25′ 05″ to 29° 59′ 20″ north latitudes and 76° 27′ 40″ to 77° 13′ 08″ east longitudes (Fig. 1). It is the sixth largest district of Haryana state with an area of 2520 km². Agriculture is the core sector of district′s economy and almost 80 per cent of the geographical area is under plough. Karnal is first ranking district for the cultivation and production of high-quality aromatic rice. With 12.24 per cent rice area of the state, the district is known as the Rice Bowl of India. There are 175 rice mills for processing and marketing of rice constituting largest agro-industry of the district.

Database and Methodology

Out of 175 rice mills in the district, 30 have been selected for field survey (Table 1). Data for the present study have been collected in the months of March and April 2018. Before starting data collection, a pilot survey has been conducted with 25 workers to understand their attitude towards questions to be asked. The main instrument for data collection is the modified version of the British Medical Research Council questionnaire. However, a few additional questions have been added, regarding socio-educational variables and use of healthcare measures. The survey schedule has been divided into four parts related to personal and work characteristics, respiratory problems, musculoskeletal disorders and use of protective measures at

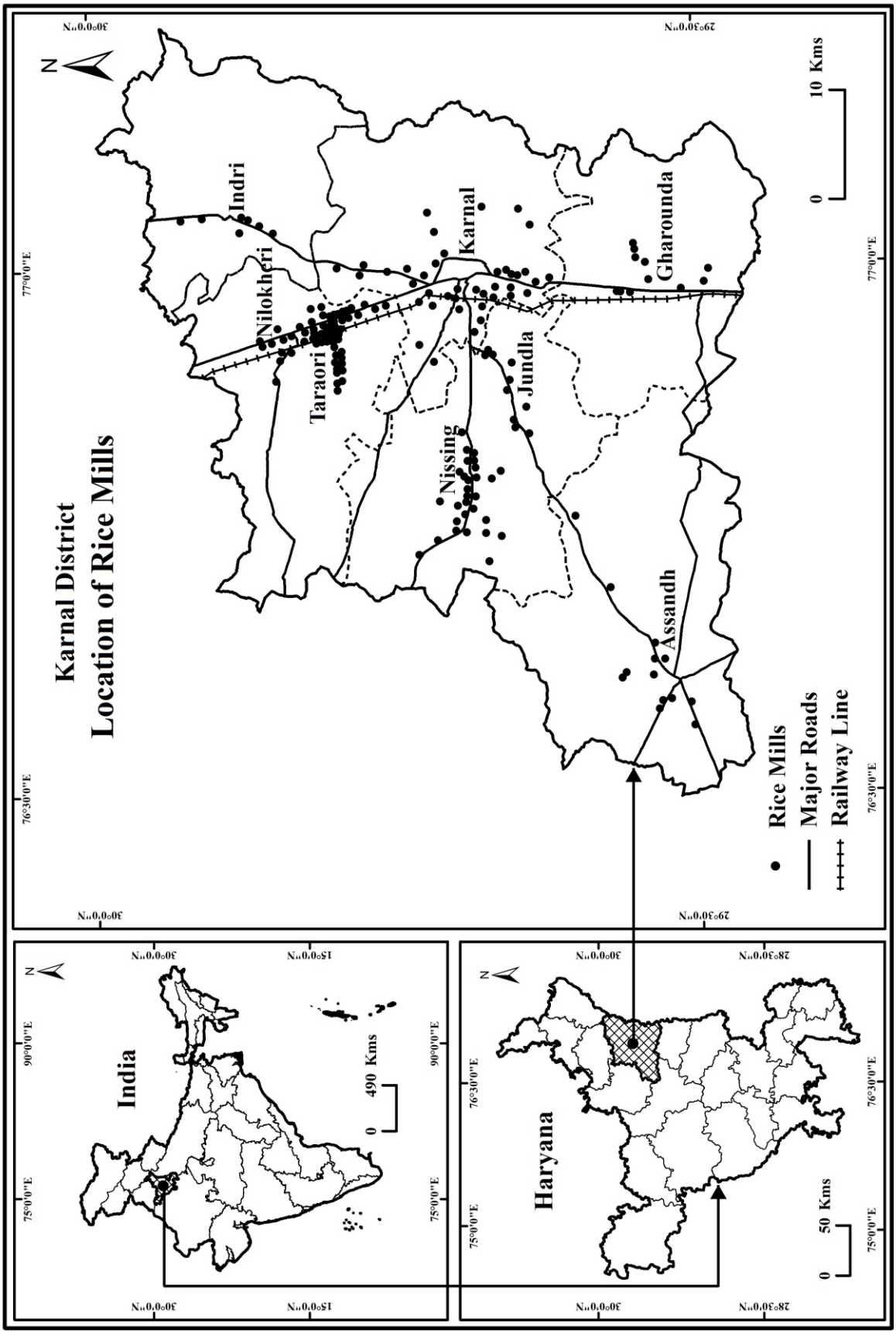

Karnal District
Location of Rice Mills
Indri
Nilokheri
Taraori
Karnal
Nissing
Jundla
Gharounda
Assandh
Rice Mills
Major Roads
Railway Line
10 Kms
0
India
490 Kms
Haryana
50 Kms
N
77°0'0"E
76°30'0"E
75°0'0"E
90°0'0"E
30°0'0"N
29°30'0"N
28°30'0"N
15°0'0"N

Fig. 1

Table 1
Karnal District: Rice Mills and Sample Workers by Rice Miller's Associations

Name of Rice Miller's Association	Rice Mills (number)	Rice Mills (per cent)	Sample Rice Mills (number)	Sample Workers (number)
Taraori	54	30.86	09	48
Karnal	40	22.86	07	35
Nissing	29	16.57	05	26
Assandh	13	07.43	02	12
Gharounda	11	06.29	02	10
Nilokheri	11	06.29	02	10
Jundla	10	05.71	02	09
Indri	07	04.00	01	06
Total	**175**	**100.00**	**30**	**155**

Source: Field Survey, 2018

workplace. The survey schedule is designed as a set of questions with fixed alternatives having only one option, either yes or no. During the survey, care has been taken to avoid the respondent being influenced by the views of other co-workers. The survey schedule has been administered by the authors personally to reduce inaccuracy of inconclusive response.

In the present study, two stage sampling technique has been applied. In first stage, stratified random sampling has been used for the selection of sample rice mills from the mills falling under each rice mill association. In second stage, three to five workers each have been randomly selected from a sample mill for survey from different work sections such as supervisors, clerks, operators, weighing workers, coolies and helpers. The workers having no history of allergic disorders, respiratory problems like extensive pulmonary disorders, bronchitis asthma, or any systemic disease have been chosen for survey. Those who have undergone chest or abdominal surgeries have been excluded from the study. Finally, 155 workers (126 males and 29 females) have been selected for the study. Out of the total 155 workers, 52 have been engaged as helpers, 43 as coolies, 29 as operators, 19 as weighers and 12 as clerks or supervisory staff (Table 2).

All workers selected for study underwent through a physical examination. Anthropometrical parameters such as height in centimeters (cm) and weight in kilograms (kg) have been measured. The chest expansion has been examined to see deformity as well as lung function capacity. A physical examination has been conducted to identify the signs of allergy, chest, nasal, eye and skin problems. The measurements include peak expiratory flow rate (PEFR) and actual/predicted PEFR ratio. Following Jain et al. (1983), the predicted PEFR has been estimated using these equations:

$$\text{Adult men} = (\text{Height in m} \times 5.48) + 1.58) - (\text{Age} \times 0.041) \times 60$$

$$\text{Adult women} = (\text{Height in m} \times 3.72) + 2.24) - (\text{Age} \times 0.03) \times 60$$

Measurement of PEFR has been done with a mini-Cipla′s breath-*o* meter/peak flow meter. Prior to recording the workers′ PEFR, the functioning of the instrument has been repeatedly demonstrated and explained to

Table 2
Karnal District: Socio-demographic Characteristics of Sample Workers

Characteristics		Number	Per cent
Gender	Male	126	81.29
	Female	29	18.71
Education	Uneducated	46	29.68
	Primary	58	37.42
	Secondary	33	21.29
	Diploma/Degree or above	18	11.61
Indigenous Inhabitant	Yes	102	65.81
	No	53	34.19
Nature of Work	Helpers	52	33.55
	Coolies	43	27.74
	Weighers	19	12.26
	Operators	29	18.71
	Clerks/Supervisors	12	7.74
Religion	Hindu	107	69.03
	Sikh	41	26.45
	Others	7	4.52
Family Structure	Nuclear	114	73.55
	Joint	41	26.45
Place of Residence	Rural	129	83.23
	Urban	26	16.77

Source: Field Survey, 2018

them. The PEFR test has been performed in standing position with the peak flow meter held horizontally. The workers have been asked to take a deep breath as far as possible and then to blow out quickly until the lungs are completely empty. Three forced expirations have been performed and the average of the three measurements has been taken as actual PEFR of a worker. For calculation of Body Mass Index (BMI), a worker′s height and weight has been used and expressed mathematically as BMI = kg/m^2, where kg is a worker′s weight in kilograms and m^2 is his height in metres squared. Finally, statistics such as mean and standard deviations have been calculated to summarise the numerical variables. Simple and multiple bar graphs and scatter plots have been drawn for graphical representation of the results.

Results and Discussion

Socio-demographic Profile

Most of the workers are indigenous inhabitants (65.81 per cent) and from the nuclear families (73.55 per cent), while 81.29 per cent are males and 18.71 per cent females (Table 2). About 30 per cent of the workers are illiterate or pre-primary and another 37.42 per cent have primary-level of education. About 83 per cent workers belong to rural areas. Religion-wise, 69.03 per cent workers are Hindus, 26.45 per cent Sikhs and 4.52 per cent from other religions. Among the workers, none has been below 18 years or above 60

Table 3
Karnal District: General Characteristics of Sample Workers

Characteristics	Workers (*n* = 155)
Age (years)	35.52 ± 5.99
Height (cm)	161.97 ± 10.58
Weight (kg)	54.33 ± 6.65
Income (Rs.)	9307.74 ± 1864.90
Chest Size (cm)	79.21 ± 5.52
Chest Expansion (cm)	3.67 ± 1.30
Working Time (hour/day)	8.77 ± 1.18
Duration of Rest (minutes/day)	45.68 ± 12.37
Duration of Employment (months)	93.27 ± 53.75

Source: Field Survey, 2018

years of age, while the mean age is 35.52 ± 5.99 years (Table 3). Similarly, the mean height, weight, and chest sizes of the workers are about 162 cm, 54 kg and 79 cm, respectively. The study also shows that average income of rice mill workers is about Rs. 9300/- per month. Mean duration of employment in rice mills is 93.27 ± 53.75 months. Workers are working 7 days in a week without any holiday. On an average, the workers work for about 9 hours a day, but duration of work varies with demand. The mean duration of rest for workers is about 46 minutes per day.

Level of Dust Exposure

Fig. 2 shows that processes like pre-cleaning of paddy, fine cleaning (husking) and husk separation produce highest level of dust. Whereas, paddy unloading, de-stoning, unloading from tank, whitening, polishing, length grading, blending, weighing and bagging are the processes where moderate amount of dust is released. Apart from this, soaking, steaming, parboiling and drying activities produce relatively low level of dust. Generation of dust is relatively high in handling and cleaning of paddy; therefore, exposure is highest among coolies and helpers. Male workers (coolies and helpers) are employed for carrying paddy sacs from godown to the dumping pit for de-husking. Such workers are working without taking any personal protective measures. Women are mostly working for drying the paddy. They also spend more time as helpers on husking machine and cleaning the floor, where they are exposed to dust. Very few workers are employed in polishing and packaging of rice, where exposure to dust is moderate. The dust exposure level is considerably low among the administrative staff.

Occurrence of Respiratory Problems

The study reveals that prevalence of respiratory problems is quite high among workers. Blocked nose, phlegm, morning sneezing, itchy nose, nose irritation, red-watery eyes and wheezing are the major respiratory problems reported by the workers (Fig. 3). Chest congestion, night time cough and chronic cough are the complaints expressed by 48.10 per cent, 22.78 per cent and 18.35 per cent of the respondents, respectively. It is assumed that respiratory difficulties such

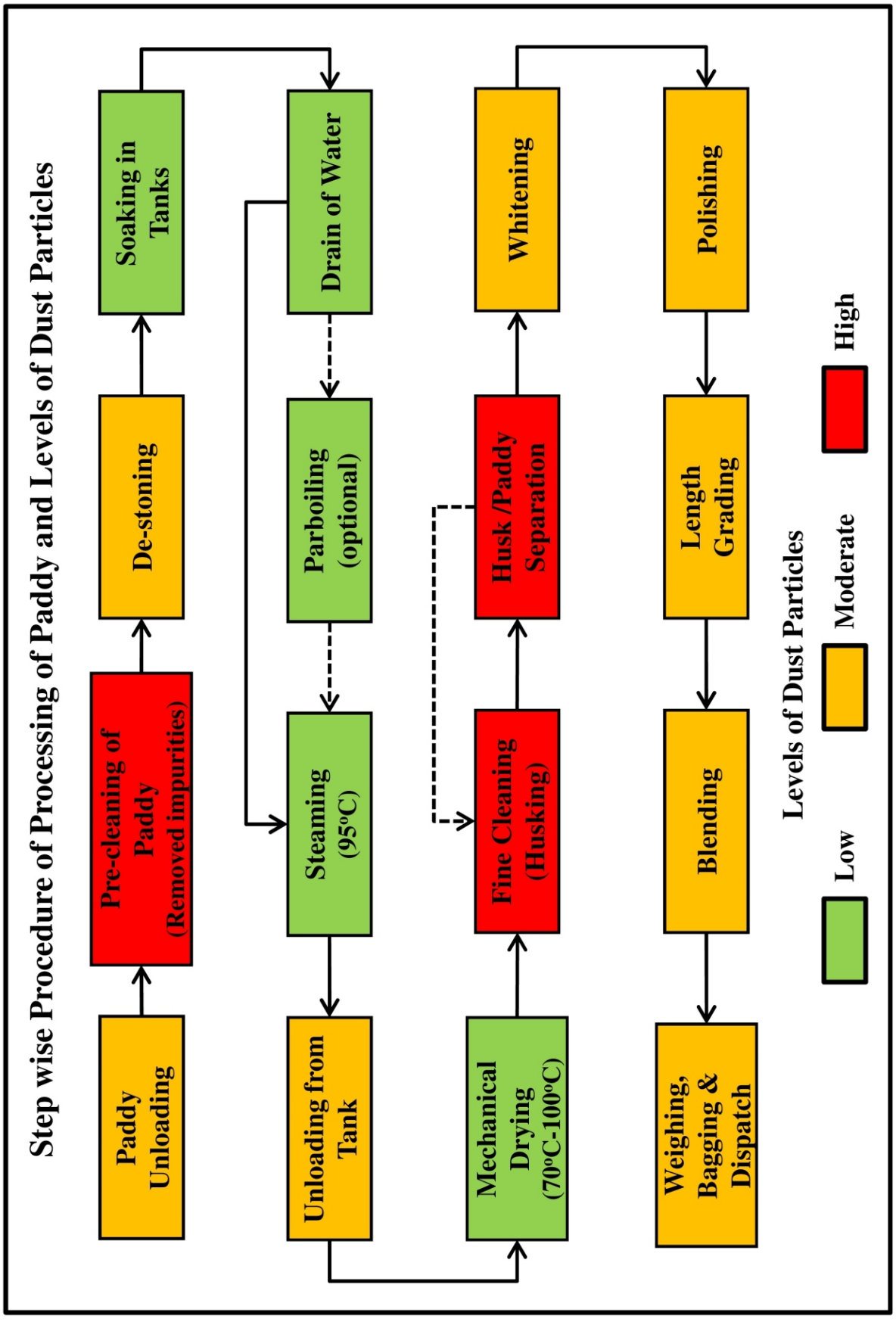

Step wise Procedure of Processing of Paddy and Levels of Dust Particles
Paddy Unloading
Pre-cleaning of Paddy (Removed impurities)
De-stoning
Soaking in Tanks
Unloading from Tank
Steaming (95°C)
Parboiling (optional)
Drain of Water
Mechanical Drying (70°C-100°C)
Fine Cleaning (Husking)
Husk /Paddy Separation
Whitening
Weighing, Bagging & Dispatch
Blending
Length Grading
Polishing
Levels of Dust Particles
Low
Moderate
High

Fig. 2

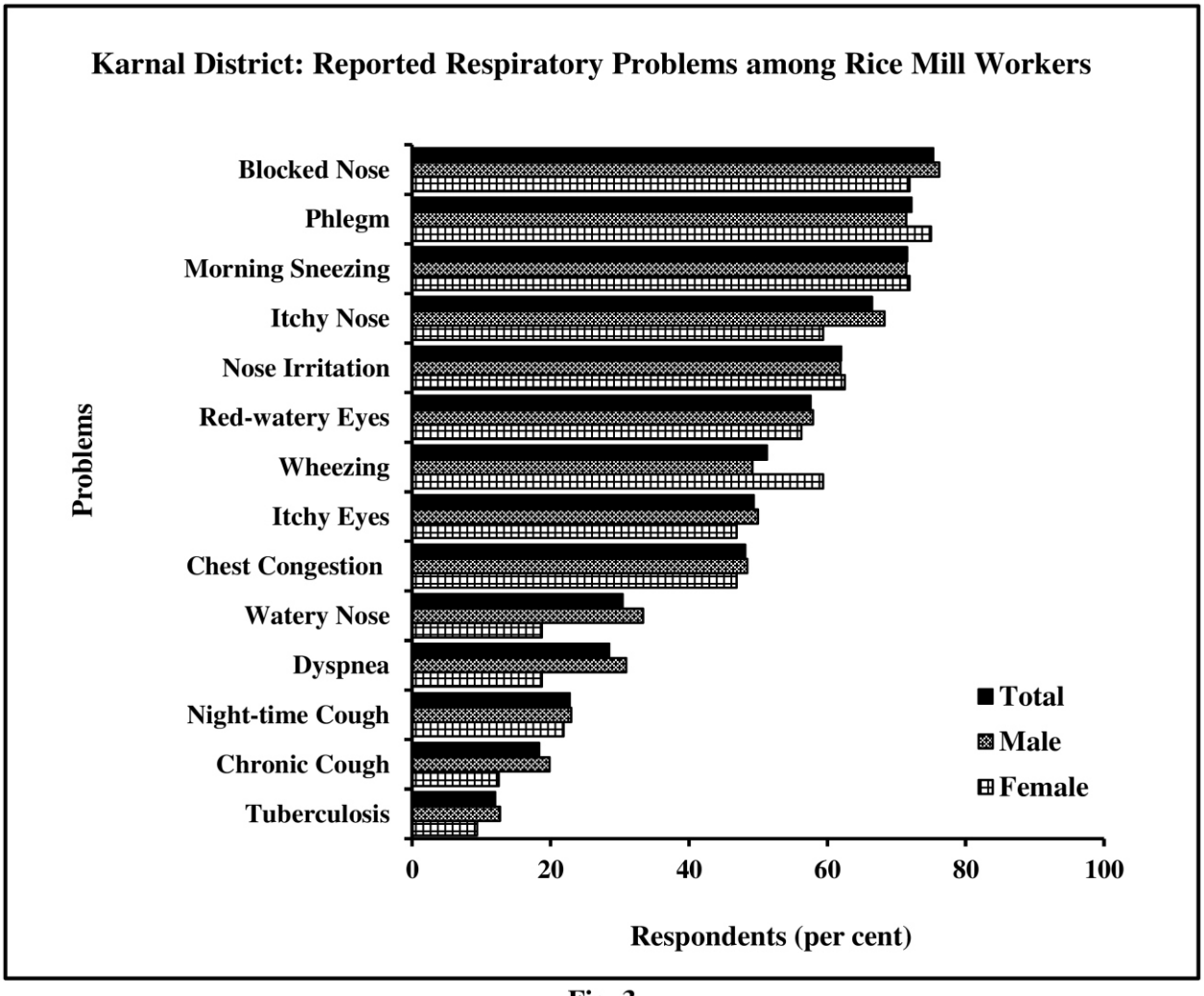


Fig. 3

as congestion of chest, wheezing and phlegm are allergic responses, either due to a protein constituent of the rice husk or to some microbiological contaminants. The irritant effects have also been noticed predominantly in the eyes of workers. The male workers have shown a higher percentage of respiratory problems compared to the female workers. About 31 per cent male workers suffer from dyspnea or shortness of breath which is higher than the female workers (Fig. 3). Similarly, chronic cough problems are 20 per cent higher in male workers than their female counterparts. Aggravation of cough problem is more in winter season due to cold. Female workers also complain nasal blockage, phlegm, morning sneezing, wheezing and eye irritation. Respiratory problems are high among the workers who are engaged with sweeping, cleaning, milling and pouring the rice grains in machines and filling the grains into sacks. Some confirmed cases of early tuberculosis have also been found. Although their treatments are going on, yet they continue to work with some precautions; because their families are depending on these workers for their survival. Remarkably, about 12.26 per cent workers have not reported any respiratory problem.

Changes in Lung Function

There has been significant difference

Table 4
Karnal District: Parameters of Lung Function of Sample Workers

Parameters	Male Workers (*n* = 126)	Female Workers (*n* = 29)	Total Workers (*n* = 155)
Actual PEFR (L/min.)	292.0 ± 85.69	178.20 ± 40.88	270.70 ± 90.81
Predicted PEFR (L/min.)	466.60 ± 21.99	307.24 ± 19.09	436.79 ± 65.92
Actual/predicted PEFR ×100	62.51 ± 18.34	58.07 ± 13.34	61.69 ± 17.56
BMI (kg/m²)	20.80 ± 1.89	22.11 ± 6.73	21.04 ± 3.37

Source: Field Survey, 2018

in spirometry findings actual/predicted PEFR ratio among the workers. The study shows that actual PEFR in workers is 270.70 ± 90.81, which is significantly lower as compared to predicted PEFR value of workers i.e. 436.79 ± 65.92 (Table 4). Both male as well as female workers have lower actual PEFR compared to predicted PEFR. These observations highlight that PEFR capacity of workers gets reduced as they are exposed to dust. This decrease in PEFR is probably due to irritation by dust resulting in the increased secretion of mucous and formation of mucosal plugs which cause obstruction to the exhaled air. The mean BMI of workers is 21.04 kg/m². In this study, BMI values for the workers have not shown a significant difference compared to the normal values. Interestingly, BMI values among male workers have been found lower as compared to female workers.

The comparison of mean and actual values of lung function abnormalities (actual and predicted PEFR) among male and female workers has been shown in Fig. 4. Significant

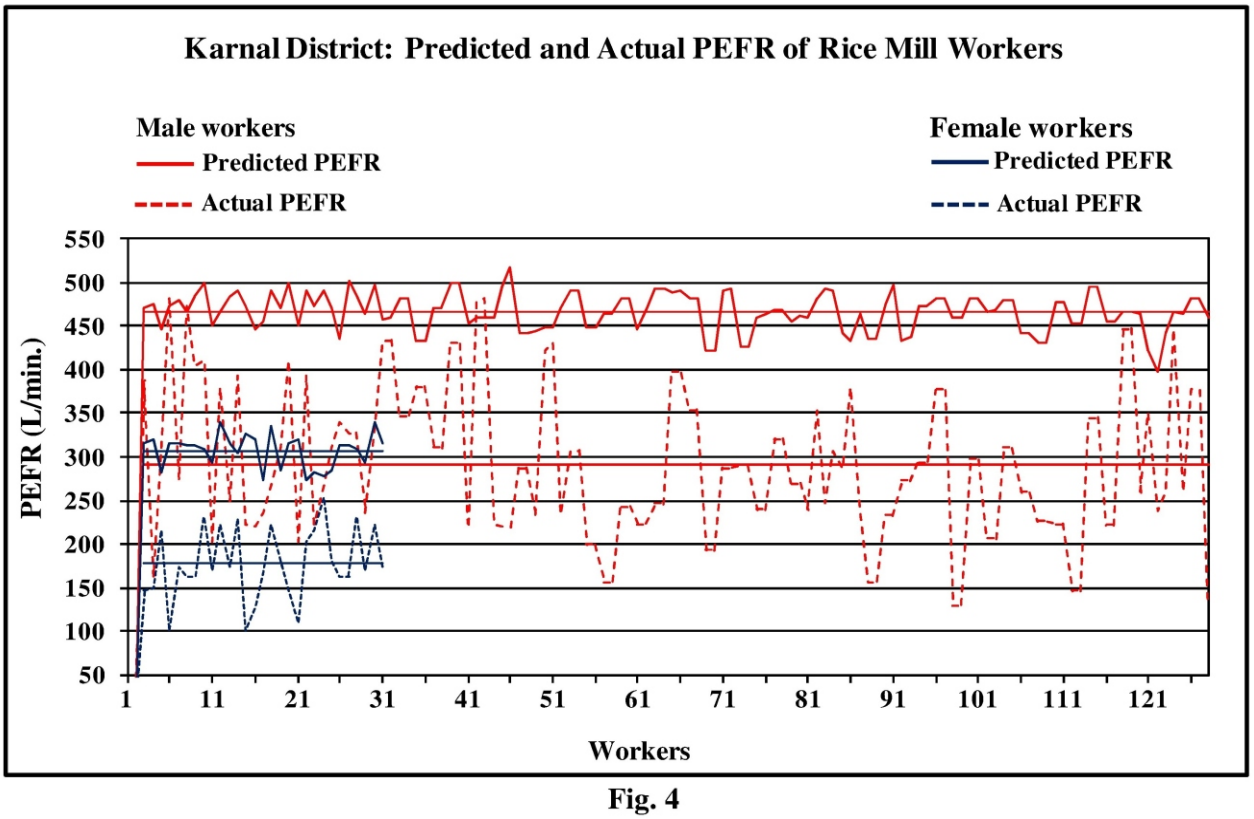


Fig. 4

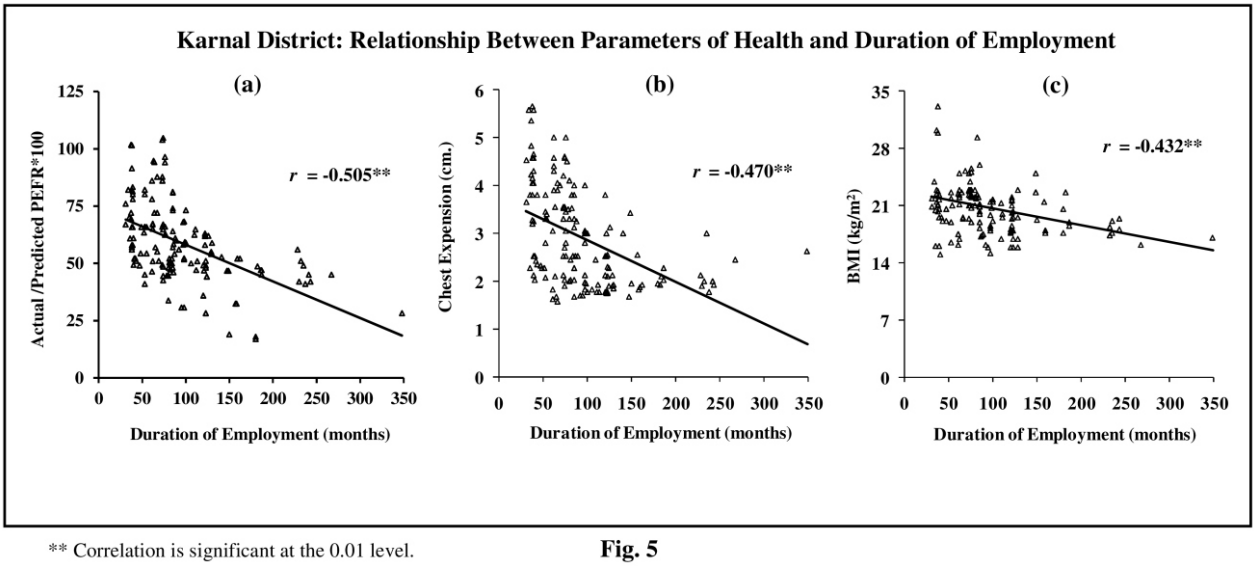
Table 5
Karnal District: Zones of Severity of Exacerbation

Personal Best PEFR to Predicted PEFR (per cent)	Severity of Exacerbation	Zone	Workers			Problems
			Male	Female	Total	
30 and Less	Life-threatening	Red	3 (2.38)	0 (0.0)	3 (1.94)	Respiratory tract is severely narrowing: Requires immediate medical check-up
30.1-50	Severe	Orange	29 (23.02)	7 (24.14)	36 (23.23)	Medical alert: Requires consulting doctor
50.1-80	Moderate	Yellow	70 (55.56)	21 (72.41)	91 (58.71)	Respiratory tract has started narrowing: Requires caution at work place
More than 80	Mild	Green	24 (19.05)	1 (3.45)	25 (16.13)	Medication is working properly: Condition is under control
Total	-	-	**126 (100.0)**	**29 (100.0)**	**155 (100.0)**	-

Source: Field Survey, 2018; Figures in parentheses are percentages

decrease in actual and predicted PEFR values has been noticed among all the workers. A large gap has been witnessed between average values of actual and predicted PEFR among males and females. The male workers have exhibited lower mean value of actual PEFR than predicted PEFR in comparison to female workers suggesting more exposure to dust resulting more congestion in their lungs.

The actual/predicted PEFR ratio results of workers have been classified as green (mild), yellow (moderate), orange (severe) and red (life threatening) zones (Table 5). These categories determine the severity of exacerbation. Among 155 rice mill workers, there are three cases (1.94 per cent) with restrictive airflow defects among the male workers but none among female workers. Another 23.23 per cent workers have problem of airflow obstruction, with the prevalence of obstructive lung disorders. The study further reveals that most of lung disorders (about 59 per cent) belong to moderate obstruction grades with poor bronchodilator response. A reduction in their lung functions is due to exposure to dust. About 16 per cent workers have a mild obstructive disorder with good bronchodilator response without significant airflow obstruction. Apart from this, most of the operators, helpers and coolies have the problems of decreased alertness, sweating, red eyes,



** Correlation is significant at the 0.01 level.

Fig. 5

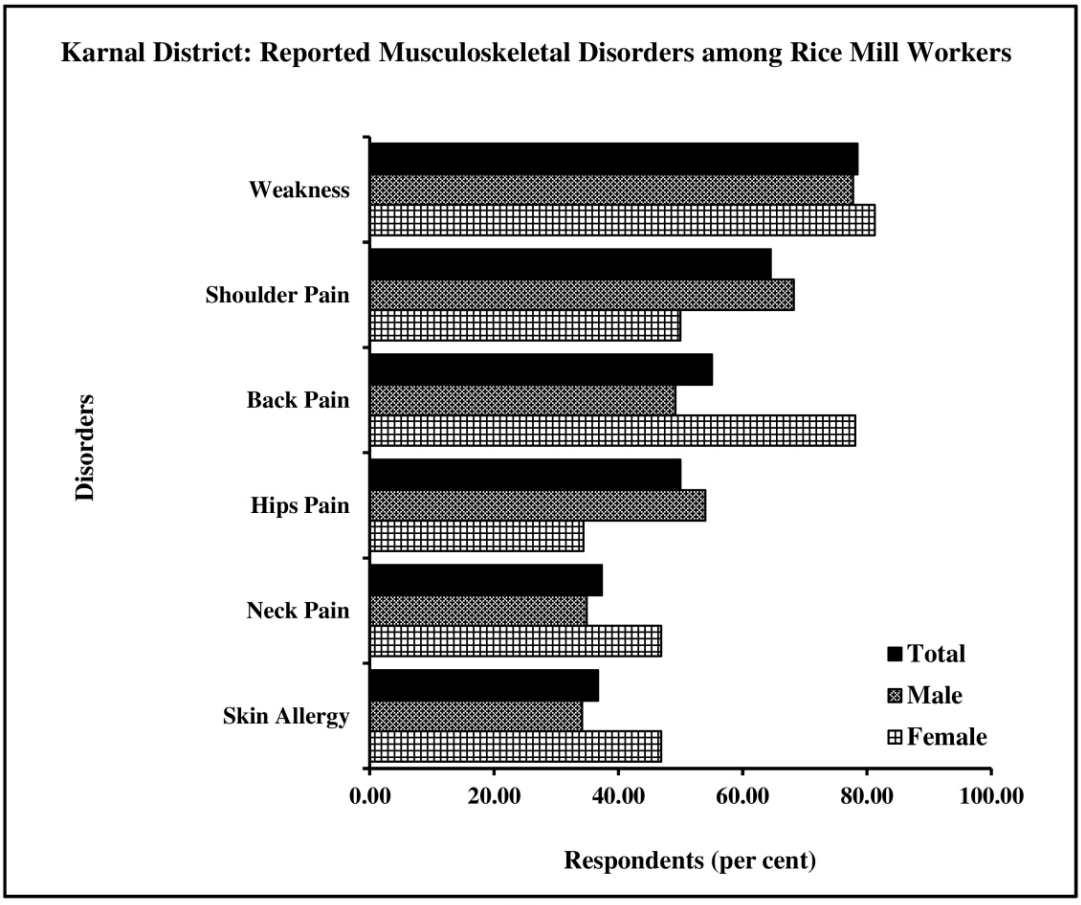

Karnal District: Reported Musculoskeletal Disorders among Rice Mill Workers
Disorders
Weakness
Shoulder Pain
Back Pain
Hips Pain
Neck Pain
Skin Allergy
Total
Male
Female
0.00
20.00
40.00
60.00
80.00
100.00
Respondents (per cent)

Fig. 6

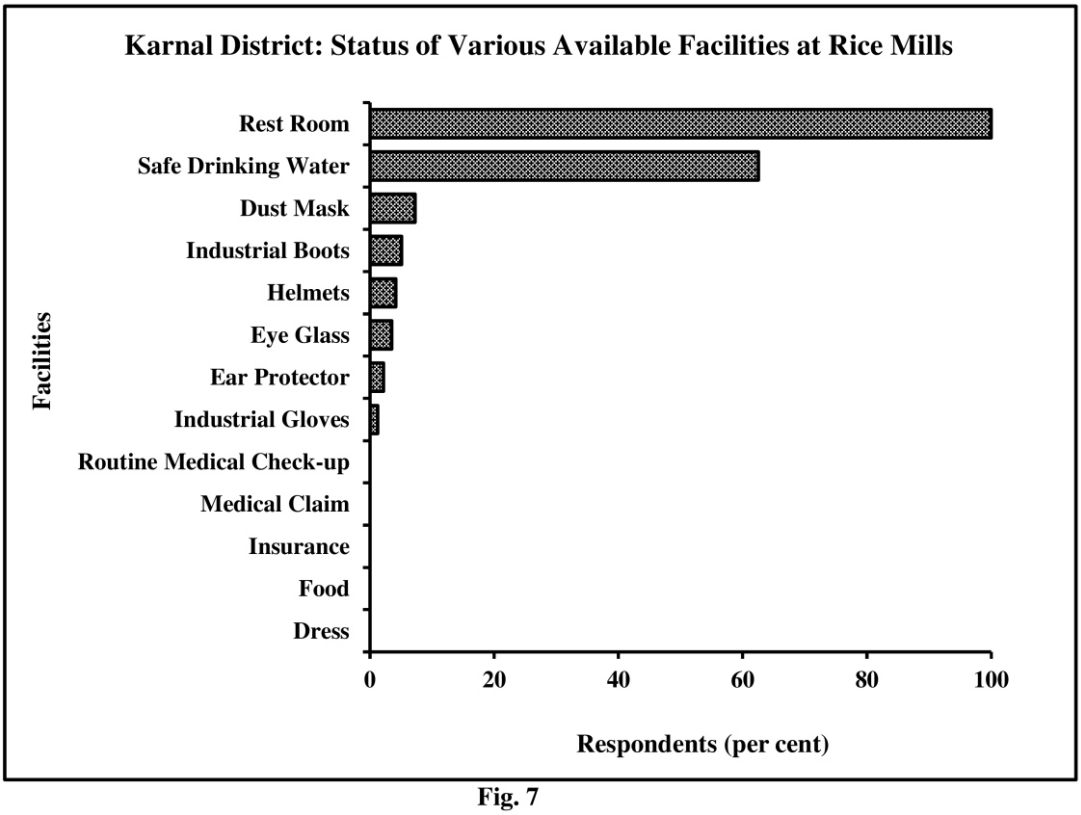

Karnal District: Status of Various Available Facilities at Rice Mills
Facilities
Rest Room
Safe Drinking Water
Dust Mask
Industrial Boots
Helmets
Eye Glass
Ear Protector
Industrial Gloves
Routine Medical Check-up
Medical Claim
Insurance
Food
Dress
0
20
40
60
80
100
Respondents (per cent)

Fig. 7

cough, bluish color of lips and raspy breathing, suggesting their exposure to dust.

Analysis reveals that lung function, chest expansion and BMI, are significantly associated with duration of employment. The ratio value of actual/predicted PEFR has been found to be decreasing significantly (r = -0.505**) with an increase in the length of exposure to rice mill dust (Fig. 5a). When the chest expansion (an indicator of lung function) of workers is correlated with duration of employment, a significant (r = -0.470**) negative correlation has been observed (Fig. 5b). The BMI is the simple and best available anthropometric estimate of health. The low values of BMI are an indicator of malnourishment and development of compromised immune function, respiratory and digestive diseases. A significant inverse correlation (r = -0.432**) has been found between BMI and duration of employment among the workers (Fig. 5c). These results of the study confirm that the duration of work in rice mills is most important predictor of respiratory problems and lung function abnormalities. Further, these results suggest that health of workers might worsen if they remain constantly exposed to rice mill dust over a long period of time.

Musculoskeletal Disorders

The most common musculoskeletal disorders are shoulder pain and back pain reported by 64.56 per cent and 55.06 per cent workers, respectively (Fig. 6). Other significant complaints are hips pain and neck pain reported by 50 per cent and 37 per cent workers respectively. About 40 per cent workers have also complained about development of skin allergy. Similarly, female workers have also reported back and shoulders pains. Female workers engaged in drying and cleaning of paddy have to perform these jobs in bending and sitting positions. Therefore, due to continuous turning, twisting and bending, females have developed back and shoulder pains. Among the male workers about 68 per cent, 54 per cent, 49 per cent and 35 per cent have respectively reported shoulder pain, hips pain, back pain and pain in the neck. It may be due to carrying heavy loads under bending position for loading and unloading of rice sacs. Handling of loads requires high muscular effort in awkward postures giving rise to musculoskeletal strains and back pain. Remarkably, most of the musculoskeletal disorders are significantly associated with duration of work.

Availability of Protective Facilities

Exposure to dust is a serious health hazard for rice mill workers. Therefore, it is essential for workers to take appropriate respiratory protective measures. It has been observed that only 7.26 per cent workers are using masks during working hours (Fig. 7). In the absence of masks, workers use their personal clothes (towel) as protective measures. Further, only 5.12 per cent of the total workers are using industrial boots, whereas helmets are being used by 4.14 per cent, eye glass by 3.47 per cent, ear protector by 2.14 per cent and industrial gloves by 1.23 per cent of workers. Further, the study reveals that all workers feel highly satisfied with availability of rest room facilities. About 38 per cent workers have reported that they are not getting safe drinking water.

Conclusions

The study concludes that processes like pre-cleaning of paddy, husking and husk separation produce highest level of dust in the rice mills. Most of the rice mills do not adopt

dust reduction measures and are working with old machineries that produce more dust. Therefore, rice mill workers are exposed to high level of dust leading to health hazards such as blocked nose, phlegm, morning sneezing, itchy nose, nose irritation etc. Similarly, musculoskeletal disorders, particularly weakness and pain in shoulders, back, and hips are common among workers. Duration of exposure to dust and non-use of protective measures such as dust masks, industrial boots, helmets, eye glasses etc. are significant determinants for such health disorders among workers. Most of the workers have reported non-availability of proper dust protective devices. Other mandatory facilities such as routine medical check-ups, medical claims, insurance, provision of food and dress are completely missing. Hence, provision of safe drinking water, availability and use of protective devices and health services such as periodic physical examination and health care programmes are essential to improve health, welfare and safety of the workers.

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