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Original Article

Lung Capacity and Respiratory Health in Rice Mill Workers

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ABSTRACT

Background: Rice mill workers are routinely exposed to grain dust, posing significant health risks, particularly in terms of respiratory health. This exposure has been linked to various pulmonary diseases, yet the extent of these risks within the rice milling industry remains insufficiently explored.

Objective: This study aimed to assess the lung capacity and respiratory health among rice mill workers in Wazirabad, focusing on the relationship between dust exposure and respiratory impairments.

Methods: A cross-sectional study was conducted from April to July 2023 among 345 workers from different rice mills in Wazirabad. Participants were selected using a non-probability convenient sampling technique, focusing on individuals aged 18-60 years, actively engaged in the mills for a minimum of four hours per day, with at least six months of employment. Exclusion criteria included workers with a history of heart failure, recent surgeries, diagnosed COPD, known allergies, and administrative staff. Pulmonary function tests (PFTs) were administered, measuring parameters such as FVC and FEV1. Data analysis was performed using SPSS version 25.

Results: The study revealed that 49.6% of the participants reported the presence of respiratory symptoms, and 39.1% had a history of respiratory infections. Pulmonary function tests showed significant declines in lung parameters among exposed workers, with reductions noted in FVC, FEV1, PEFR, and FEV1/FVC ratio. Implementation of dust control measures showed a notable decrease in dust concentration.

Conclusion: The study highlights a significant correlation between dust exposure in rice mills and impaired lung function among workers. This underscores the need for improved dust control measures and regular health monitoring in rice milling environments to safeguard worker health.

Keywords: Rice Mill Workers, Respiratory Health, Lung Function, Dust Exposure, Occupational Health, Pulmonary Function Tests.

INTRODUCTION

Lung capacity, a critical indicator of respiratory health, refers to the total lung volume inhaled during maximum inspiration, typically around 6 liters for healthy individuals (1). The rice milling process, starting from grain harvesting to the production of rice after de-husking, exposes workers to substantial amounts of dust, posing a significant risk to their pulmonary function (2). This descriptive cross-sectional study was conducted to explore the prevalence of respiratory symptoms and lung functions among rice mill workers, a demographic crucial to the global rice supply chain, as over half of the world's population relies on rice as a primary food source (5).

In rice mills, workers encounter both organic and inorganic dust, including rice husk with a high concentration of silica, which is known to adversely affect the respiratory system (5). This exposure is particularly concerning due to the high prevalence of respiratory ailments linked to organic dust from such industries. Moreover, the use of protective equipment is often inadequate in this sector, increasing workers' vulnerability to occupational hazards and leading to long-term complications in lung function (6). Various stages of rice processing, such as threshing and transportation of paddy, also involve exposure to fungal spores in improperly stored grain, which can exacerbate lung inflammation (7).

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The socio-economic importance of the rice milling industry, especially in developing countries like India, cannot be overstated. It provides substantial employment opportunities, primarily to those from lower socio-economic backgrounds (8). However, this employment comes with significant health risks. Inhaling endotoxin-contaminated rice dust can cause respiratory difficulties, including asthma, persistent bronchitis, and chronic obstructive pulmonary disease (COPD) (9). Additionally, pulmonary function tests (PFTs), particularly spirometry, are crucial for detecting a range of respiratory conditions, from asthma and allergies to chronic pulmonary diseases (10).

Long-term exposure to industrial dust, such as that found in rice mills, can lead to proliferative and fibrotic changes in the lungs (11). The most significant occupational hazard in this environment is not just the dust but also the noise generated by machinery, with about 25% of workers exposed to noise levels exceeding 85 dBA (12). The susceptibility to acute respiratory infections (ARI) in this workforce is influenced by various factors, including nutritional status, duration of dust exposure, and cumulative years of service (13).

Chronic obstructive pulmonary disease (COPD) is a major public health concern globally, with principal causes being air pollution and tobacco use (14). Grain dust exposure in rice mills can adversely affect multiple organs, highlighting the importance of lung function testing in identifying early signs of lung dysfunctions (15). Notably, environmental health and safety regulations are often not adhered to in the rice milling industry, leading to occupational health risks due to the lack of enforcement of safety legislation, technology, and public awareness (16).

This study aims to assess the lung capacity and respiratory health of workers in rice mills, with a particular focus on the rice dumping station, identified as the highest risk area for respiratory issues. The findings underscore the need for preventive measures to minimize dust particle exposure, essential for safeguarding the health of workers in this vital industry (17). The study's outcomes are anticipated to inform strategies aimed at enhancing occupational health standards, particularly in areas with high dust pollution.

MATERIAL AND METHODS

The study, a descriptive cross-sectional analysis, was conducted over a four-month period from April to July 2023, in Wazirabad. Data were collected from four rice mills: A-One Rice Mill, Abdullah Rice Mill, Iteefaq Rice Mill, and Mian Rice Mill. A total of 345 participants were selected through a non-probability convenient sampling technique, focusing on individuals aged 18 to 60 years. The inclusion criteria encompassed all categories of employees actively engaged in the mills, working for a minimum of four hours per day and with an employment duration of at least six months (19).

Those excluded from the study included individuals with a history of heart failure, recent thoracic or abdominal surgery, diagnosed chronic obstructive pulmonary disease (COPD), known allergies, and administrative or office workers. This exclusion was necessary to ensure the homogeneity of the sample concerning the study's focus on respiratory health related to dust exposure (19). The equipment used for data collection comprised a measuring tape, a weight machine, and an Incentive spirometer, ensuring precise and standardized measurement of physical and respiratory parameters.

Data collection entailed the recording of demographic information, occupational history, and a detailed assessment of lung function using the Incentive spirometer. Participants underwent spirometry tests, with parameters like Forced Vital Capacity (FVC) and Forced Expiratory Volume in the first second (FEV1) being recorded. These measurements were crucial in evaluating the lung capacity and respiratory health of the workers.

In terms of data analysis, the collected data were systematically coded and entered into SPSS version 25 for statistical analysis. The analysis included descriptive statistics to summarize demographic and occupational characteristics, along with inferential statistics to explore the relationships between dust exposure and respiratory health outcomes. The use of SPSS 25 facilitated a comprehensive and nuanced interpretation of the data, allowing for the identification of significant patterns and correlations within the sample.

RESULTS

The histogram depicts the age distribution of research participants in a study, with a sample size of 345 individuals. It shows a bell-shaped curve characteristic of a normal distribution, suggesting that the majority of participants cluster around the mean age of 43.41 years, with fewer individuals at the younger and older ends of the age spectrum. The spread of ages is captured by the standard deviation of 13.88 years, indicating a moderate range of age variation within the sample. The bars of the histogram represent age intervals, and their height corresponds to the number of participants falling within each interval. The distribution appears slightly right-skewed, implying a larger proportion of participants in the middle-age range, with a gradual decrease in frequency as age increases beyond the mean.

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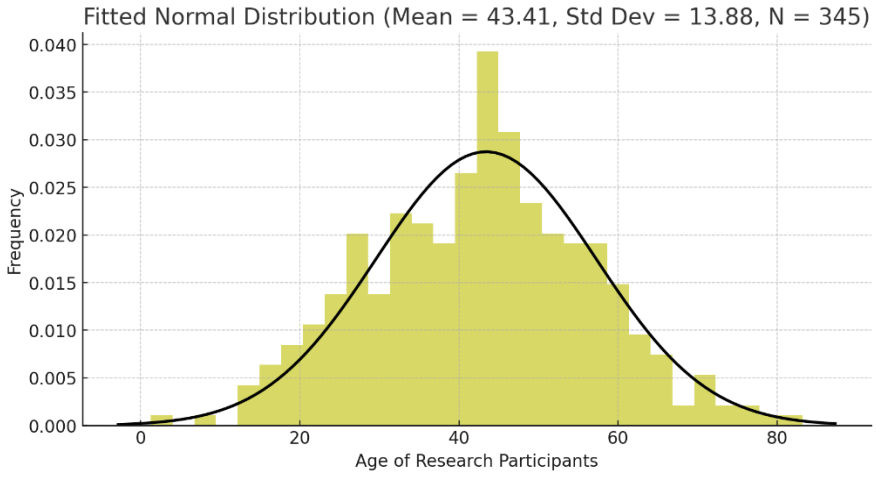

Figure 1 Age

In the investigation of respiratory health among rice mill workers, a detailed analysis of the Breathlessness, Cough, and Sputum Scale (BSCSS) scores was conducted. The distribution of scores indicated that 30.7% of participants had scores ranging from 0-4, suggesting minimal symptoms. Another 38.6% fell within the 5-8 score range, implying moderate symptoms, while an equal proportion of the sample, 30.7%, scored between 9-12, indicative of more severe symptoms. Overall, the total number of participants in this scoring system was 345, ensuring a comprehensive assessment of respiratory health across the spectrum of the BSCSS (Table 1).

Further scrutiny of respiratory health parameters revealed that 49.6% of the participants reported the presence of respiratory symptoms, whereas 50.4% did not. This nearly even split highlights the significant prevalence of respiratory issues within the cohort. In terms of past health history, 39.1% of the workers had a history of respiratory infections, contrasting with 60.9% who reported no such history. This aspect underscores the impact of environmental exposure on respiratory health among industrial workers (Table 2).

Additionally, the study examined the usage of protective equipment, a critical factor in occupational health. It was found that a slight majority, 52.2%, of the workers used protective equipment, while 47.8% did not utilize any protective measures. The data on protective equipment usage are particularly telling, suggesting a correlation between exposure to occupational hazards and the incidence of respiratory symptoms (Table 2).

Table 1 Breathlessness, Cough, and Sputum Scale (BSCSS) Scores among Participants

BSCSS Score Range	Frequency	Percent (%)
0-4	106	30.7
5-8	133	38.6
9-12	106	30.7
Total	345	100.0

Table 2 Combined Table: Respiratory Health and Protective Measures Among Participants

Criteria	Yes	No	Total	Percent (%)
Presence of Respiratory Symptoms	171	174	345	100.0
History of Respiratory Infections	135	210	345	100.0
Usage of Protective Equipment	180	165	345	100.0

These results collectively provide valuable insights into the respiratory well-being of workers in rice mills, highlighting the need for improved occupational health practices and interventions to mitigate the risks associated with respiratory symptoms, infections, and the varying levels of BSCSS scores observed.

DISCUSSION

The study conducted in the Wazirabad district aimed to elucidate the prevalence and severity of respiratory ailments among rice mill workers, with the cohort comprising 345 individuals. The findings illuminate a pronounced prevalence of respiratory symptoms within this population, a trend that mirrors and, in some instances, exceeds observations from comparable research within similar occupational settings (20). The symptomatic profile, characterized by coughing, phlegm production, breathlessness, and wheezing, is indicative of the pervasive nature of respiratory health challenges prevalent among those routinely exposed to grain dust—a risk factor that has been well-documented in literature (20).

Grain dust, specifically from rice milling that includes husk and potential contaminants such as silica, fungi, aflatoxin, and insect parts, was implicated as a substantial risk factor. It has been observed that the levels of dust exposure vary significantly across different operational sections of rice mills, often surpassing the permissible exposure limits, especially in feeding areas (21). Such environments provide a nidus for both acute and chronic respiratory conditions, thereby impacting workers' health.

Pulmonary Function Tests (PFTs), which were systematically administered to the workers, disclosed a stark decline in lung function parameters, notably Forced Vital Capacity (FVC), Forced Expiratory Volume in the first second (FEV1), Peak Expiratory Flow Rate (PEFR), and the FEV1/FVC ratio when juxtaposed with age- and BMI-matched controls from non-exposed groups. The observed reduction in FVC suggests a restrictive lung disease pattern, hinting at alterations in the bronchial and elastic fibers of lung tissue (23).

In response to the findings, the study proposed the adoption of dust collection systems within the high-exposure zones of feeding and sieving areas in rice mills. Utilization of air streams to capture airborne particulates led to a marked decrease in the concentration of total and respirable dust, thus aligning exposure levels with occupational health standards. This intervention showed potential benefits beyond the immediate areas of implementation, extending to polishing and packaging sections as well (24).

The research highlights the critical need to address dust exposure as a preventive measure against respiratory conditions among rice mill workers. The correlation between advancing age and diminished lung function underlines the vulnerability of older workers to occupational dust exposure. While the implementation of dust collection systems showed encouraging results, the study is not without limitations. The cross-sectional design precludes establishing causality, and the study did not account for confounding variables such as smoking and outdoor air pollution, which may have influenced respiratory health. Furthermore, the lack of longitudinal follow-up limits the understanding of the long-term effects of dust exposure on lung function.

In conclusion, the study reveals a clear association between occupational exposure to rice mill dust and impaired lung function, substantiated by the deterioration in parameters such as FEV1, FVC, and the FEV1/FVC ratio. The presence of dust in the working environment stands as a significant correlate to the heightened occurrence of respiratory symptoms, thus calling for targeted interventions. Future research should aim to incorporate longitudinal designs, adjust for a broader range of confounders, and consider the role of personal protective equipment usage in mitigating occupational hazards. The incorporation of such measures is anticipated to further substantiate the findings and reinforce the recommended interventions.

CONCLUSION

The study conducted among rice mill workers in Wazirabad concluded that occupational exposure to grain dust significantly impairs lung function, as evidenced by reduced FVC and FEV1 values, and is associated with an increased prevalence of respiratory symptoms. These findings have important implications for occupational health policies, underscoring the need for the implementation of effective dust control systems, such as localized exhaust ventilation, and the promotion of protective equipment usage. Additionally, they highlight the necessity for regular health surveillance programs to monitor the respiratory health of workers, particularly those of advancing age who are more susceptible to dust-related respiratory impairments. The study's outcomes advocate for a re-evaluation of current workplace safety standards and underscore the urgency for interventions that could mitigate the health risks faced by this vulnerable workforce.

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