

# Effect of Exposure to Flour Dust on Inspiratory Muscle Strength, Peak Expiratory Flow Rate and Chest Expansion of Flour Mill Workers of Ahmedabad City

Khushi Tahiliani<sup>1</sup>, Harita Vyas<sup>2</sup>

<sup>1</sup>Post Graduate Student, SBB Physiotherapy College, Ahmedabad.

<sup>2</sup>Lecturer, SBB Physiotherapy College, Ahmedabad.

Corresponding Author: Khushi Tahiliani

DOI: <https://doi.org/10.52403/ijshr.20250411>

## ABSTRACT

Due to increase in industrialization, air pollution is increasing day by day. Occupational lung diseases are caused by a pathologic response of the individual to their working environment. Prolonged exposure to occupational dust which varies by dust type and exposure duration, particularly in flour packaging workers, can lead to respiratory diseases that resulting in reduced respiratory muscle strength, which negatively impacts both clinical outcomes and quality of life. Hence, present study aimed to evaluate inspiratory muscle strength, peak expiratory Flow Rate and Chest Expansion among Flour-Mill Workers in Ahmedabad city. A cross-sectional study conducted on 20 flour mill workers aged from 44-60 years. Verbal consent was taken from these workers along with control group 20 middle aged healthy adults (age, gender matched). The inspiratory muscle strength (Pimax) was calculated using portable capsule sensing pressure gauge device. Peak expiratory Flow Rate (PEFR) was calculated using peak expiratory flow meter. Best of Three readings of Pimax and PEFR in both the groups were taken. Chest expansion measured with measuring tape at all three levels in both groups. Significant

reduction in Pimax ( $z < 0.002$ ), Chest expansion at fourth intercostal ( $z < 0.00$ ) and Xiphoid Level ( $z < 0.00$ ) was observed in Flour Mill Workers. PEFR was not statistically reduced ( $z < 0.95$ ) in both groups. Study result showed that there is significant reduction of inspiratory muscle Strength and Chest Expansion in Flour-Mill Workers. This study highlights the need for industrial respiratory health monitoring programs and data-driven public and occupational health initiatives for enhancing safety of flour-mill workers.

**Keywords:** Chest expansion, Flour Mill Workers, Flour dust, Inspiratory muscle strength.

## INTRODUCTION

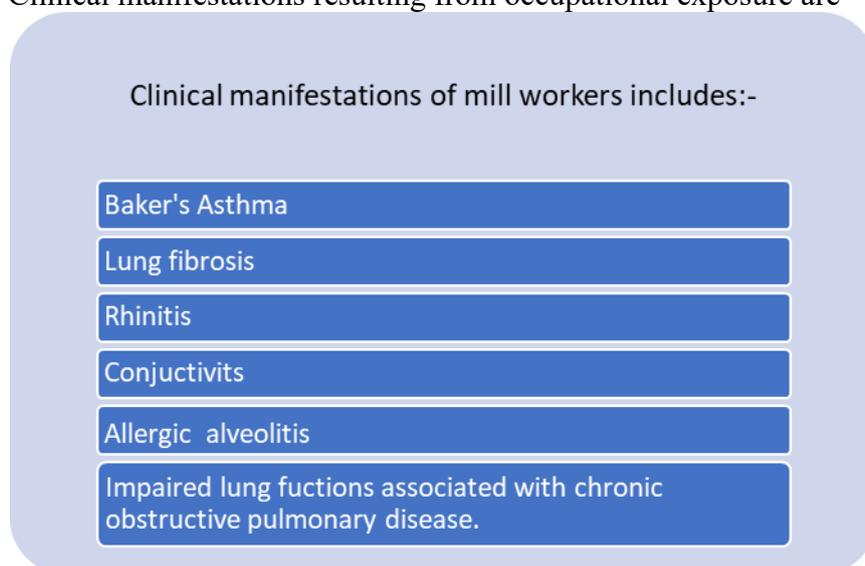
Industrialization has been established to optimally fulfill various human needs but over the time; it exerts hazardous effect on health of human beings [1]. International Labour Organization (ILO) report indicates more than 2.4 million workers die from work related diseases and accidents each year. Flour Mills produce a large amount of flour dust; on average flour mill worker are exposed to their work place for 8 to 10 hours a day with no provisions for minimization of dust produced by flour

mills [7]. Variable amounts of organic dust are generated and released into the work environment during different industrial processes involving flour such as cleaning, milling, packaging, storage and loading which can be inhaled. Also, Poor ventilation is a basic problem in flour mills that have continuous exposure of workers. Wheat flour is a complex organic dust with a large diversity of antigenic or allergic components [2]. Gliadins and glutelin, which make up about 80% of wheat flour proteins play an effective role in allergic diseases.

Also, albumins and globulins are the major contributing proteins in hypersensitivity reactions to flour dust.

These mill workers in India commonly use silica containing grinding stones and may have risk of developing silicosis amongst them [3]. Due to such risk, they have tendency to develop reduced chest compliance which results into more force generation by inspiratory muscles for same volume change which might turn lead to develop inspiratory muscle weakness.

Clinical manifestations resulting from occupational exposure are [4]:



**Inspiratory muscle strength:** Measurement of maximum inspiratory pressure (MIP) is the most prevalent method used in clinical practice to assess the strength of the inspiratory muscles. MIP reflects the force-generating ability of the combined inspiratory muscles during a brief-static contraction, thus reflecting the strength of the inspiratory muscle. Measurement of maximum inspiratory pressure (MIP) is a simple, quick and non-invasive clinical procedure for determining inspiratory (diaphragm) muscle strength.

**Peak expiratory flow rate (PEFR):** It is the maximal expiratory flow rate sustained by a subject for at least 10 milliseconds expressed in Litre per minute (L/min) [9]. PEFR is a simple, reliable, reproducible and

easily measurable Ventilatory lung function test.

**Chest expansion:** The degree of chest wall mobility depends on several determinants including elasticity of soft tissue structures surrounding the thorax, chest shape, and strength of the respiratory muscles [10]. Chest wall expansion may be useful in clinical practice to evaluate chest wall mobility.

Hence there is need arise to study the effect of Flour Dust on inspiratory muscle strength, peak expiratory flow rate and chest expansion in flour mill workers.

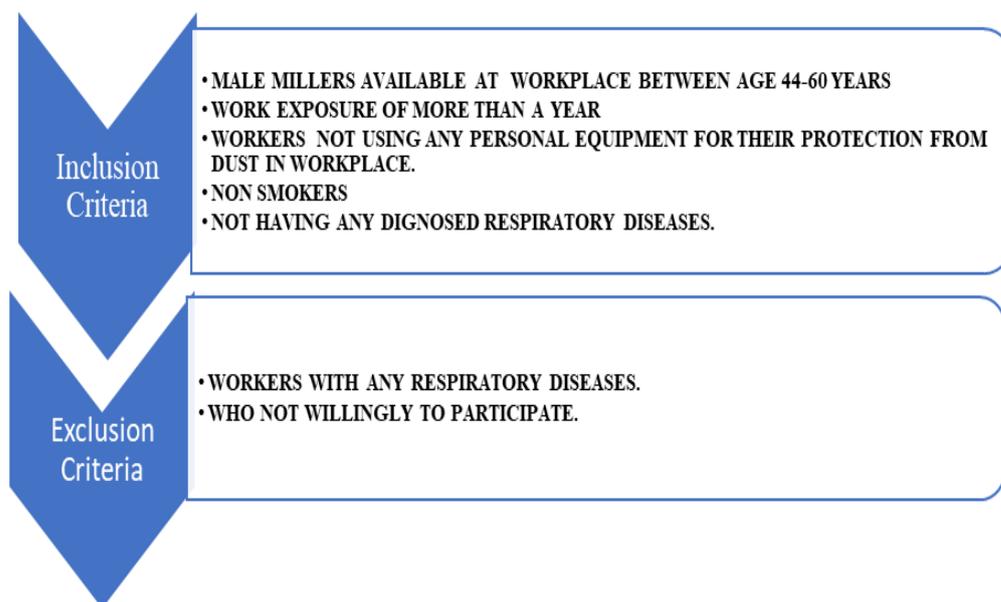
## MATERIALS & METHODS

**Study Setting:** Flour mills, Ahmedabad City

**Study Type:** Cross Sectional study

**Sample size:** 40 individual age group between 44-60years in Ahmedabad city in

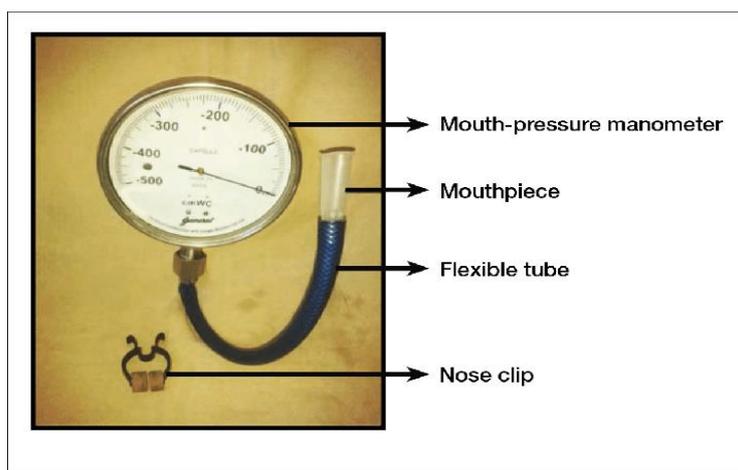
which there were 20 flour mill workers and 20 healthy unexposed (to any flour dust) middle aged individuals.



Participant falling in to inclusion criteria were invited for study. Prior verbal consent was taken and test procedure was explained.

**INSPIRATORY MUSCLE STRENGTH (Pimax):** Participant was instructed to be seated in comfortable sitting position. The Pimax was calculated using portable capsule

sensing pressure gauge device.<sup>[6]</sup> The participant was asked to hold the gauge with both hands and to close his or her lips firmly around the flanged mouthpiece and instructed to inhale maximally against the resistance of the gauge. Three Inspiratory efforts were taken and one of the best was taken in both the groups.



**PEAK EXPIRATORY FLOW RATE (PEFR):** It was calculated using peak expiratory flow meter. Participant should asked to take deep breath then exhale it by forceful expiration as fast as possible after maintaining air tight seal between lip and

mouth piece of the instrument. Three readings were taken and one of the best taken in both the groups.

**CHEST EXPANSION:** The measurements were taken in the standing position with the

arms hanging sideways at all the three different anatomical landmarks i.e. 2<sup>nd</sup> intercostal, 4<sup>th</sup> intercostal and Xiphoid levels in both the groups.

### STATISTICAL ANALYSIS

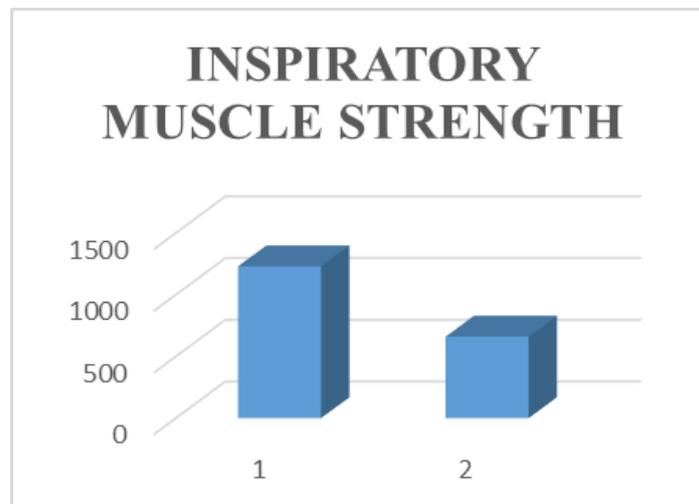
Data Analysis was performed using SPSS version 20. Wilcoxon signed ranked test for between group analyses. Level of significance was kept at 5%

### RESULT

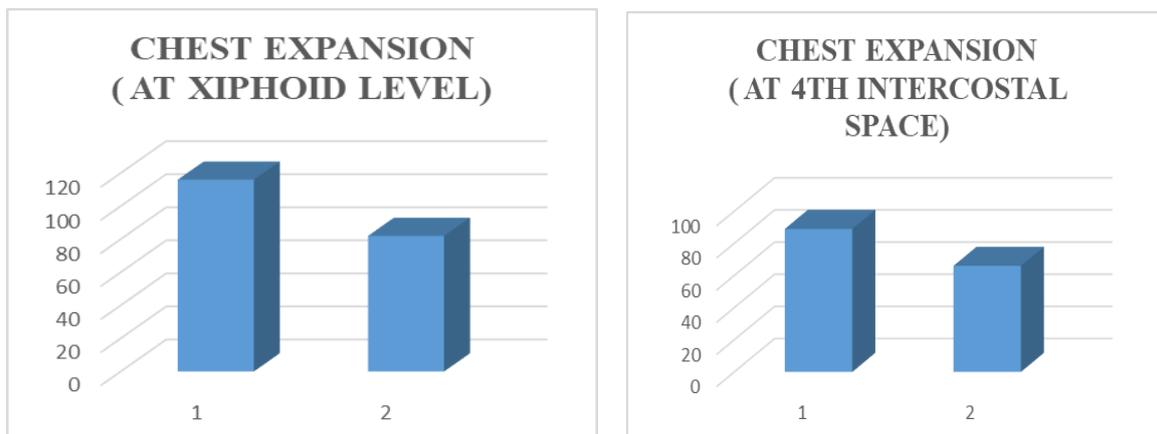
Mean age of workers: 44.21± 9.472. Significant reduction in Pimax ( $z < 0.002$ ), chest expansion at 4<sup>th</sup> intercostal space ( $z < 0.001$ ) and xiphoid level ( $z < 0.001$ ) were observed in flour mill workers. PEFR was not statistically reduced ( $z < 0.95$ ) in both the groups.

TABLE 1: Mean (SD) of outcome measures for both the groups

Parameters	Flour mill workers Mean ± SD	Control group Mean ± SD	Z value
Pimax	33±11.28	61.5±26.41	0.002
PEFR	339±102.69	342±159.92	0.90
Chest expansion at 2 <sup>nd</sup> intercostal	2.75±0.44	2.95±0.44	0.10
Chest expansion at 4 <sup>th</sup> intercostal	3.30±0.57	4.45±0.51	0.001
Chest expansion at Xiphoid level	4.1±0.71	5.8±0.61	0.001



GRAPH 1: Showing Inspiratory muscle strength of Healthy adults (1) & Flour mill workers (2)



GRAPH 2: Showing chest expansion of healthy adults (1) & flour mill workers (2)

## DISCUSSION

Results of these study reveals that there was reduction in inspiratory muscle strength, chest expansion at 4<sup>th</sup> Intercostal and Xiphoid level in flour mill workers. There is a growing consensus on the deleterious effects of organic dust on respiratory symptoms and functions of industrial workers. Industrial dust inhalation like flour dust over a long period leads to proliferative and fibrotic changes in lungs. Realizing the hazardous nature of flour dust, the statutory body American Conference of Governmental Industrial Hygienists (ACGIH(R)) proposed a Threshold Limit Value (TLV(R)) of 0.5 mg/m<sup>3</sup> of flour dust with a sensitization notation [8]. With reference to ACGIH(R) value several studies have reported exceeded level of flour dust at workplace and also reported minimal/ no usage of Personal Protective Equipment (PPEs) which further raise a serious concern towards preventive/ control measures at workplace.

Accumulation of Silica cause reduction in chest compliance which results into more force generation by inspiratory muscles for same volume change which might turn lead to develop inspiratory muscle weakness. Ankur et al. conducted a study “Effectiveness of respiratory muscle training on pulmonary function and quality of life in cotton industry workers” on 100 male workers for 4 weeks and reported that respiratory muscle training is essential to pulmonary rehabilitation for improving lung function and quality of life for those employed in this cotton industry.

Current study revealed that the spectrum of included flour mill workers didn't have any statistically reduction in PEFR. We have preferred to measure peak expiratory flow rate in silica exposed workers to see whether any obstructive changes also occurred in such workers along with restrictive pathology. [5] Seema Prakash et al. conducted a study “Morbidity patterns among rice mill workers: A cross-sectional study” on 75 workers of three mills to

measure the PEFR and chest expansion among them and concluded that there is high prevalence of respiratory morbidity with decreased PEFR and chest expansion amongst rice mill workers.

The flour mill workers of present study had 17.5±14.27 years of exposure to flour dust. The higher prevalence of respiratory symptoms may be explained by relatively prolonged exposure, unhygienic conditions and poorly ventilated work places where the study was carried out. The flour dust particles easily enter the respiratory tract of an exposed person. The inner cell wall of the respiratory tract does not accept the foreign particles (flour dust), causing a slight irritation in the respiratory tract which is the primary symptom of respiratory disorder. Karjalainen et al. found that the longer the duration of employment to such workplace the higher the prevalence of allergic symptoms.

## CONCLUSION

The results from the present study indicate that exposure to flour dust in flour mills leads to reduction in inspiratory muscle strength and chest expansion among the workers.

## Limitations

The study limitations are the small sample size; the subjects taken for this study were males only. All the workers had different years of experience.

## Future Recommendations

The future studies can be done on subjects with different occupations exposed to such harmful dust particles like silica and other enzymes, for both the genders with larger sampler size.

Other parameters like functional capacity, PFT & breath holding time can also be assessed among such workers.

## Clinical Implications

The use of protective devices such as respiratory masks and goggles by these

workers should be promoted in order to reduce the occupational exposure to dust. Regular exercise, including chest wall mobility and respiratory muscle strengthening, should be incorporated into the daily routine of such workers

Occupational Health services should be provided to these workers, which includes routine health checkups, Health education and rationalization of work methods so as to improve the health and safety of the workers.

#### **Declaration by Authors**

**Acknowledgement:** None

**Source of Funding:** None

**Conflict of Interest:** The authors declare no conflict of interest.

#### **REFERENCES**

1. Demeke D, Haile DW. Assessment of respiratory symptoms and pulmonary function status among workers of flour mills in Addis Ababa, Ethiopia: comparative cross-sectional study. *Pulmonary medicine*. 2018;2018(1):9521297.
2. Mohammadien HA, Hussein MT, El-Sokkary RT. Effects of exposure to flour dust on respiratory symptoms and pulmonary function of mill workers. *Egyptian journal of chest diseases and tuberculosis*. 2013 Oct 1;62(4):745-53.
3. Athavale A, Iyer A, Sahoo D, Salgia K, Raut A, Kanodra N. Incidence of silicosis in flourmill workers. *Indian Journal of Occupational and Environmental Medicine*. 2011 Sep 1;15(3):104-8.
4. Meo SA. Dose responses of years of exposure on lung functions in flour mill workers. *Journal of occupational health*. 2004 May;46(3):187-91.
5. Tiwari RR, Sharma YK, Saiyed HN. Peak expiratory flow and respiratory morbidity: a study among silica-exposed workers in India. *Archives of medical research*. 2005 Mar 4;36(2):171-4.
6. Jalan NS, Daftari SS, Retharekar SS, Rairikar SA, Shyam AM, Sancheti PK. Intra-and inter-rater reliability of maximum inspiratory pressure measured using a portable capsule-sensing pressure gauge device in healthy adults. *Canadian journal of respiratory therapy: CJRT= Revue canadienne de la therapie respiratoire: RCTR*. 2015;51(2):39.
7. Wagh ND, Pachpande BG, Patel VS, Attarde SB, Ingle ST. The influence of workplace environment on lung function of flour mill workers in Jalgaon urban center. *Journal of occupational health*. 2006 Sep;48(5):396-401.
8. Karpinski EA. Exposure to inhalable flour dust in Canadian flour mills. *Applied occupational and environmental hygiene*. 2003 Dec 1;18(12):1022-30.
9. Al-Amin M, Kabir L, Amin R. Peak expiratory flow rate (PEFR) - a simple ventilatory lung function test. *Institute of child and mother health Matuail Dhaka*. 2009; 13:1-1.
10. Padkao T, Boonla O. Relationships between respiratory muscle strength, chest wall expansion, and functional capacity in healthy nonsmokers. *Journal of exercise rehabilitation*. 2020 Apr 28;16(2):189.

How to cite this article: Khushi Tahiliani, Harita Vyas. Effect of exposure to flour dust on inspiratory muscle strength, peak expiratory flow rate and chest expansion of flour mill workers of Ahmedabad City. *Int. J. Sci. Healthc. Res.* 2025; 10(4): 70-75. DOI: <https://doi.org/10.52403/ijshr.20250411>

\*\*\*\*\*