International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

Original Research Article

Effects of Breathing Exercise and Preventive Measure on Pulmonary Functions in Flour Mill Workers

Prerna M. Tawde[1], Atharuddin H. Kazi [2], Sambhaji B. Gunjal[3], Amit V. Jaiswal[1], Aashirwad A. Mahajan[3], Subhash M. Khatri[4]

[1]Post Graduate Student, [2]Associate Professor, [3]Assistant Professor, [4]Principal,
Department of Cardio-Respiratory Physiotherapy, College of Physiotherapy, Pravara Institute of Medical Sciences (PIMS), Pravara Rural Hospital, Pravara Deemed University, Loni.413 736

Corresponding Author: Prerna M. Tawde

Received: 22/05/2015 *Revised: 19/06/2015* *Accepted: 29/06/2015*

ABSTRACT

Background: Agriculture is the backbone of Indian economy. Industrialization is leading to an increase in indoor air pollution eventually causing an increase in morbidity and mortality. Flour mill workers are exposed to flour dust during their work hours in flour mills. Prolong exposure to dust results in chronic lung problems which leads to decrease in PFT values.
Purpose: The purpose of this study was to determine the effects of breathing exercise and preventive measure on PFT values of participants working in flour mills and to assess the PFT values in participants working in flour mills.
Methods: The prospective experimental pre & post test study consisted of fifty two participants between the age group of 20-65 years working in the flour grinding shop for more than 6 hours a day for more than 5 years. According to the reading obtained by PFT, the participants were given different breathing exercise for a period of 12 weeks.
Results: The result showed that there was a significant difference in the pre and post test scores of PFT values like FVC ($p<0.05$); FEV1/FVC ratio ($p<0.05$) and MVV ($p<0.05$); whereas there was no change in FEV1 ($p>0.05$). In participants having restrictive lung disorder there was no significant difference in the PFT values FVC ($p>0.05$) and FEV1 ($p>0.05$) after 12 weeks of intervention when paired t test was used.
Conclusion: The study concluded that breathing exercise and use of a preventive measure improved the PFT values in flour mill workers.

Keywords: Flour Mill Worker, PFT values, Restrictive Lung Disorder.

INTRODUCTION

India is one of the fastest developing countries of the world. Its population has tremendously increased in the past few years. According to the recent release of the figures of the last government censes carried out in 2011, India's population has crossed 1.21 billion and of these 1.21 billion, 833 million reside in rural areas and 377 million reside in urban areas of the country. [1] Agriculture is the backbone of Indian economy and it plays the most crucial role in the socio-economic condition of the country. The workers of the agricultural industry are

highly exposed to harmful factors in their working environment; such as dust, unfavourable microclimatic conditions, excessive noise and insufficient light. [2-4] Health effects from exposure to indoor air pollutants may be experienced soon after exposure or even in some cases after many months or years.

In 1713, Bernardino Ramazzini (1633–1714), described the health hazards associated with few occupations. [5,6] An occupational disease is a disease contracted as a result of an exposure to risk factors arising from work. Occupational lung diseases are a group of illnesses that are caused by either repeated, extended exposure or a single, severe exposure to irritating or toxic substances leading to acute or chronic respiratory ailments. [7] Recognition of the occupational origin of a disease, at the individual level, requires the establishment of a causal relationship between the disease and the exposure of the worker to certain hazardous agents at the workplace.

According to the International Standardization Organization (ISO) "Dust is defined as small solid particles, conventionally taken as those particles below 75 μm in diameter, which settle out under their own weight but which may remain suspended for some time." [8] Health effects resulting from exposure to dust may become obvious only after long-term exposure; this is often the case with pneumoconiosis. It may happen that, effects appear even after exposure has ceased.

Flour dust is a complex organic dust with varied composition, including particles of husk, cuticular hair, pollen, starch grain, bacteria and mucous spore. [9,10] In India, flour production is predominantly in the small scale industry (unorganized sector) and milling is accomplished by grinding grain between stones and a steel wheel. In urban areas, due to busy lifestyle, many people buy readymade package flour as its less time consuming and readily available. There are small scale flour mill shops in cities as well but less in number as compared to the rural setup. Recently several studies have reported high exposure levels to total and respirable dust in mill workers [11,12] and have documented that there is an increased risk of respiratory diseases due to the exposure to flour dust. [14] On average, flour mill workers are exposded to the work place environment for 8-10 hours a day and there are no provisions for minimization of the dust produced in the flour mill. In India, especially in small scale setup because of lacunization in infrastructure and due to low economic condition of the people, there are poor facilities in their work place. One of such poor basic facility is poor ventilation. Due to this poor ventilation, flour dust accumulates in the workplace environment and hence the workers get exposed to excessive amount of flour dust. [2] The flour mills should have an exhaust system to tackle the excessive flour dust.

Occupational lung diseases if detected early and treated appropriately can significantly reduce the morbidity as well as mortality rate and will have a great impact on patient outcome. [4] Spirometry is one of the most important diagnostic tools in occupational respiratory diseases. Although occupational lung diseases may not be cured completely, they can be prevented. Improving ventilation, wearing protective equipment, changing work procedures and educating workers about work hazards are the key factors for prevention. [13,15]

Most of the research studies in present literature conducted on flour mill workers are survey based studies to evaluate the pulmonary function test in them. Very few interventional and preventive studies on flour mill workers are conducted and published in the literature. Hence, this study

was carried out in flour mill workers to study the effects of breathing exercise and preventive measure on pulmonary function test values.

MATERIALS AND METHODS

The research design used for the study was prospective experimental pre & post test study. The sampling method used for the study was purposive sampling. The sample size of 40 participants working in flour mill shops was selected based on inclusion and exclusion criteria and a written informed consent was obtained from them. They were explained about the nature of the study and intervention in the language best understood by them (In Marathi). The participants were asked to perform breathing exercise twice a day for seven days a week for a period of 12 weeks. The duration for each session was 5-10 minutes which also include the rest period. They were asked to breathe 6 breaths per minute [16] and perform the exercise before starting the work in morning and at the end of their work in evening. They were also asked to wear a cloth face mask during their work hours in flour mill shops. The inclusion criteria for this study was both male and female participants within the age group of 20-65 years working in the flour grinding shop for more than 6 hours a day and for more than 5 years [2] and those who were willing to participate in the study. The exclusion criteria for this study were participants having signs and symptoms of respiratory infection at the time of testing, abnormalities of thoracic spine, chronic debilitating neuromuscular disorders and cardiac disorders. [3,4,17,18,19]

OUTCOME MEASURES

Pulmonary Function Test: Forced Vital Capacity (FVC), Forced Expiratory Volume in One Second (FEV_1), FEV_1/FVC ratio and Maximum Voluntary Ventilation (MVV). These specific measurements were computed by the instrument called spirometry (RMS HELIOS 401). The study received approval from Institutional Ethical Committee (Ref. no. PIMS/CPT/IEC/ 2014/1492) of Pravara Institute of Medical Sciences.

PROCEDURE: A total of 52 participants working in flour mill shops were screened and 40 participants who fulfilled the inclusion and exclusion criteria were requested to participate in the study. A total of 38 participants (34 Males and 4 Females) completed the study with 2 drop outs. Participants were briefed about the study and the intervention and informed written consent was obtained. Before starting the intervention, participants were assessed for the baseline parameters of Forced Vital Capacity (FVC), Forced Expiratory Volume in One Second (FEV_1), FEV_1/FVC ratio and Maximum Voluntary Ventilation (MVV) with the help of spirometry. At the end of the 4^{th} week (1^{st} month), 8^{th} week (2^{nd} month) and 12^{th} week(3^{rd} month) all the participant were reassessed with same outcome measure, for the effects of conditioning due to the intervention.

As per the reading obtained by the PFT, the participants were given different breathing exercise. The participants with restrictive pattern were asked to perform slow deep breathing exercise, the participants with obstructive pattern were asked to perform pursed lip breathing exercise, the participants with mixed pattern were asked to perform both slow deep breathing exercise and pursed lip breathing exercise while the participants having no lung function impairment were asked to perform slow deep breathing exercise as a precautionary measure to prevent any lung impairments. All the participants were asked to wear a face mask during their work hours in mills. Regular tract of the intervention was done by contacting the flour mill

workers through telephone communication or by visiting them personally.

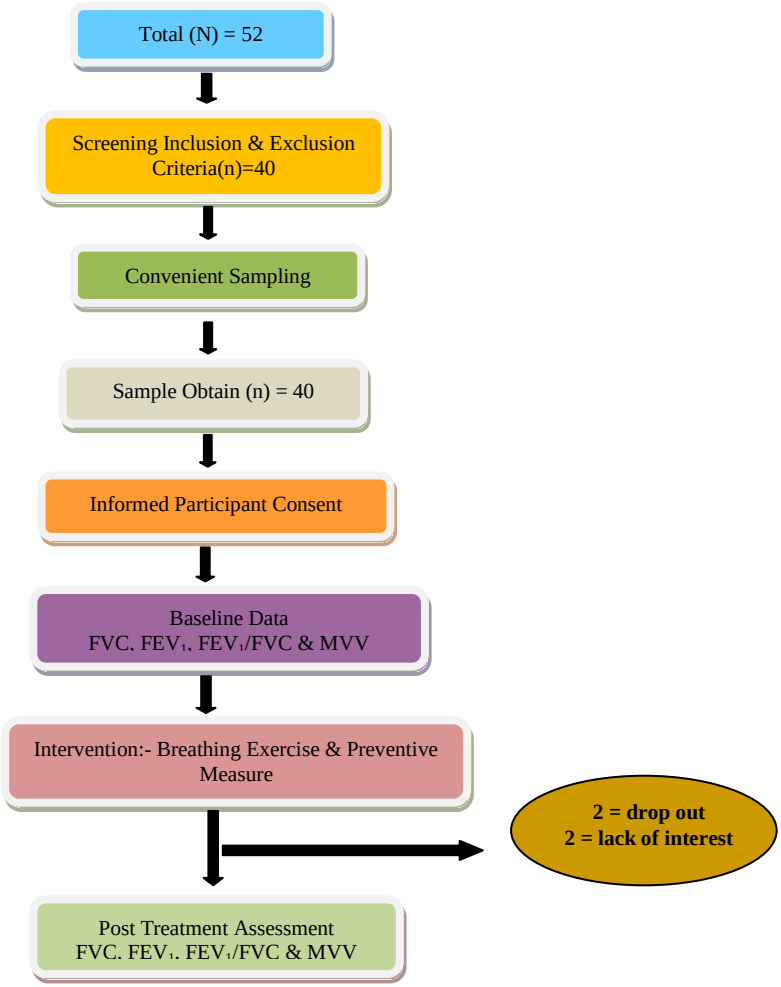

Figure: 1 Flow chart representing the procedure.

DATA ANALYSIS AND RESULTS

Statistical analysis was done by trial version of Graph Pad InStat (v 3.06) software and 'paired t test' was utilized to analyze the data.

The results of this study found that in all the flour mill workers there was a significant difference in the baseline (0 week) reading that was taken on the first day of the intervention and at the end of the 12th week in scores of Pulmonary Function Test values like FVC in Litres and % Predicted ($p<0.05$); FEV1/FVC ratio in Litres and % Predicted ($p<0.05$) and MVV in Litres and % Predicted ($p<0.05$); whereas there was no change in FEV_1 in Litres and % Predicted ($p>0.05$) and suggested that the breathing exercise and the use of a simple face mask helped to increase the lung functions. Similarly, in flour mill workers having restrictive lung disorder there was no significant difference in the Pulmonary Function Test values like FVC in Litres and % Predicted ($p>0.05$) and FEV_1 in Litres and % Predicted ($p>0.05$) after 12 weeks of intervention when compared to the baseline values. This suggests that there was no further detoriation in the lung function parameters due to the use of face mask and breathing exercise.

TABLE 1.A Demographic profile

	Interventional group
AGE(YEARS)	36.4736 ±9.046
GENDER(Males/Females)	17:2
HEIGHT(cm)	164.8684 ±8.936
WEIGHT (kg)	61.8947 ±11.722
BMI(m^2/kg)	22.8131 ±4.040

TABLE 1.B The total number of flour mill workers having different lung impairments are as follows:-

Sr No.	Lung disorder	Total no. Of Participants	Percentage
1	NORMAL	6	16
2	RESTRICTIVE	29	76
3	OBSTRUCTIVE	2	5
4	MIXED	1	3

TABLE 2 :-Comparison of FVC in Litres Scores at Pre Intervention and Post Intervention in Total Flour Mill Participants.

FVC in Litres	Pre Intervention	Post Intervention	p value	t value	Degrees of freedom	Mean Difference
Mean±SD	2.2781±0.5134	2.3084±0.5176	p<0.05	t=2.867	37	0.03026

TABLE 3 :-Comparison of FEV_1 in Litres Scores at Pre Intervention and Post Intervention in Total Flour Mill Participants.

FEV_1 in Litres	Pre Intervention	Post Intervention	p value	t value	Degrees of freedom	Mean Difference
Mean SD	2.1178±0.5161	2.1360±0.5153	p>0.05	t=1.737	37	0.01816

TABLE 4 :-Comparison of FEV_1/FVC in Litres Scores at Pre Intervention and Post Intervention in Total Flour Mill Participants.

FEV_1/FVC in Litres	Pre Intervention	Post Intervention	p value	t value	Degrees of freedom	Mean Difference
Mean SD	93.3684±10.943	92.9736±10.837	p<0.05	t=3.582	37	0.3947

TABLE 5 :-Comparison of MVV in Litres Scores at Pre Intervention and Post Intervention in Total Flour Mill Participants.

MVV in Litres	Pre Intervention	Post Intervention	p value	t value	Degrees of freedom	Mean Difference
Mean SD	71.3157±25.797	73.6578±26.446	p<0.05	t=8.429	37	2.342

DISCUSSION

The present study was conducted at the respective site of flour grinding shops and in the Department of Cardio-Respiratory Physiotherapy, Pravara Rural Hospital, Loni and in Primary Health Care (PHC) Centre of PRH at Rahata. Pre and post PFT values were measured by computerized spirometry on first day (0 week) and last day of intervention (12^{th} week). After performing the PFT, majority of the participants were found out to be having restrictive lung disorder, others having no lung function impairment and very few participants having obstructive and mixed lung disorder. The total of 38 participants completed the study; and after performing PFT, 29 participants were diagnosed having restrictive lung disorder. 6 participants had their PFT values within normal limits and had no lung impairment. 2 participants were diagnosed having obstructive lung disorder and 1 participant had mixed lung disorder.

Some of these participants were making use of a face mask or cloth to cover their nose and mouth. One of the flour mill worker had installed a dust exhaust machine to reduce the flour dust at his worker place.

Forced Vital Capacity (FVC): The finding of the present study revealed that there has been a significant improvement in FVC ($p<0.05$) at the end of 12 weeks of intervention in all flour mill workers but there was no significant improvement in FVC ($p>0.05$) in flour mill workers having restrictive lung disorder when given breathing exercise and asked to wear a face mask during their work hours. Similar findings were reported by Awad et. al., [20] Meo S. A., [9] Nayak Y. et. al. [20] Decreased FVC is a common feature of restrictive disease and its reduced when any disease affects the action of the chest or distensability of lung tissue. The physiological mechanism underlying the increase in FVC by deep breathing is probably due to deep inspiration and deep expiration with increased chest expansion. The decrease in FVC may be due to much more changes to the bronchi and elastic

component of lungs resulting in restrictive type of lung impairment. [21,22]

Forced Expiratory Volume in One Second (FEV_1): FEV_1 is a measurement of the volume of the exhaled air in the first second of FVC. [23] It's a forced maneuver [24] and most widely used spirometric parameter, particularly for assessment of airway obstruction and it is decreased in restrictive conditions. [25] The finding of the present study revealed that there was no significant improvement in FEV_1 ($p>0.05$) at the end of 12 weeks of intervention in all flour mill workers but a significant improvement in FEV_1 ($p<0.05$) in flour mill workers having no lung impairment when given breathing exercise and asked to wear a face mask during their work hours. Similar results were reported by Meo S. A, [17] Dhillon S. K. et. al. [21] and Deshpande A. A. et. al. [4]

Post et al., (1998) showed an annual decline in FEV_1 and Maximal Mid-Expiratory Flow (MMEF) were significantly related to occupational exposure to dust in grain processing and in the animal feeding industry. [17,26] Fall in FEV_1 among the flour mill workers may be attributed to accumulation of flour dust particles in the lung airway and due to the resultant mucosal hypertrophy. [2,3] AlaEldin Hassan Ahmed et al.(2009), observed that prolonged exposure to flour dust causes reduction in both FEV_1 and FVC. [27] Wagh N. D. Et al. (2006), conducted a field study to study the health problems related to the workplace environment of flour mill workers in Jalgaon Urban Center and concluded that there was a significant reduction in lung function parameters like FVC and FEV_1 in flour mill workers when compared to the control group. This reduction in the lung function parameters in flour mill workers was due to the excessive exposure to fine organic dust present in the workplace environment. [2]

FEV_1/FVC Ratio: The FEV_1/FVC ratio is based on the values of FEV_1 and FVC, and it may be different from the ratio obtained from single maneuver. [25] The finding of the present study revealed that there was a significant improvement in FEV_1/FVC ratio ($p<0.05$) at the end of 12 weeks of intervention in all flour mill workers when given breathing exercise and asked to wear a face mask during their work hours. In restrictive lung disease there is stiffening of the lung parenchyma, which reduces the lung expansion. This further leads to decrease in the lung compliance. [28] Ige and Awoyemi (2002), investigated the occupation induced lung function impairment in bakery workers as a result of exposure to grain and flour dusts. They reported that the mean values of FVC, FEV_1, PEFR, and FEV_1/FVC% in the bakery workers were significantly lower than those of the control subjects. [3,9,20,29] Hosseinabadi M.B. et al.(2013), conducted a study to study quantitative assessment of total and respirable dust exposure using standard methods and determine relationship between dust exposure and lung indices and concluded that there was a significant difference between the lung volumes such as FVC, %FVC, FEV_1, %FEV_1, %FEV_1/FVC, PEF and %PEF between the exposed and control groups. They also concluded that there was an urgent need for preventive programs and the use of appropriate respiratory mask in reducing the exposure to flour dust. [11]

Maximum Voluntary Ventilation (MVV): MVV is the volume of air exhaled in a specific interval during rapid, forced breathing. [25] The finding of the present study revealed that there has been a significant improvement in MVV ($p<0.05$) at the end of 12 weeks of intervention in flour mill workers. MVV tests the overall function of the respiratory system. It is influenced by airway resistance, respiratory muscles, compliance of the lung and chest wall, and ventilator control mechanism. [25]

MVV is considered to be a good guideline of the mechanical efficiency of the lungs. [18,21] The mechanical efficiency of the lung in flour mill workers is decreased because of the entry of the grain dust, which further decreases the MVV of the lung. [18] Increased airway resistance and inadequate mucociliary clearance occurs due to chronic exposure to massive dust. The decrease in MVV among the flour mill workers may be due to the accumulation of flour dust particles in the lung airways. [2,4]

In restrict lung disease, there is an increased resistance to lung expansion due to the decrease in the pulmonary compliance and decrease in the lung destensibility. [30] Deep breathing exercise helps to revert this state, by increasing the compliance and tissue distensibility. Deshpande A.A. et al.(2014), conducted a study to study the effect of flour dust on the lung functions in workers exposed to flour dust and they concluded that the pulmonary functions like FVC, FEV_1, FEV_1/FVC, $FEF_{25-75\%}$, PEFR and MVV were decreased in flour mill workers when compared to control group. [4] Dhillon S.K. et al.(2011), conducted a study to evaluate the lung functions in rice and flour mill workers and concluded that the respiratory parameters were decreased with increase in the duration of exposure to flour dust and rice husk dust. [21]

The limitations of the present study were that the flour mills included for the study were located very far away from each other. Due to this, it was time consuming. Convincing the participants to get them screened for any lung function impairment was very difficult.

CONCLUSION

This study concludes that 12 weeks of breathing exercise and use of a face mask by the flour mill workers during the work hours in flour mills was effective in improving the pulmonary functions and preventing the further deterioration of lung function in them.

REFERENCES

1. Pingle S. Occupational Safety And Health in India: Now and the Future. Industrial Health. 2012; 50: 167-171.
2. Wagh N.D., Pachpande B.G., Patel V.S., Attarde S.B., Ingle S.T. The Influence of Workplace Environment on Lung Function of Flour Mill Workers in Jalgaon Urban Center. Journal of Occupational Health. 2006; 48: 396-401.
3. Ragiv Gandhi University of Health Sciences, Karanataka, Bangalore. Kumbhojkar B. A comparative study of lung function in flour mill workers and general population; 2012.
4. Deshpande A.A., Sharma A., Bondade S.Y., Brid S.V. A Comparative Study Of Lung Functions In Flour Mill Workers And General Population. International Journal of Bioassays. 2014; 3(1): 1678-1681.
5. Hirschmann J.V, Pipavath S.N., Godwin D. Hypersensitivity Pneumonitis: A Historical, Clinical, and radiologic Review. Radio Graphics. 2009; 29: 1921-1938. Published online 10.1148/rg.297095707.
6. Dunn P.M. Perinatal Lessons From The Past. Dr. Ramazzini(1633-1714) and the occupational diseases of midwives and wet nurses. Archives of Disease in Childhood. 1993; 68: 337-339.
7. American Lung Association. Occupational Lund Disease. American Lung Association State of Lung Disease in Diverse Communities. 2010. www.lungusa.org1-800-LUNG-USA
8. WHO/SDE/OEH/99.14. Hazard Prevention and Control in the work Environment: Airborne Dust .p. 1-96. http://www.who.int/occupational_health/publications/en/oehairbornedust3.pdf
9. Meo S. A., Al-Dress A. M. Lung Function Among Non-Smoking Wheat Flour Mill Workers. International Journal of Occupational Medicine and

Environmental Health. 2005; 18(3): 259-264.
10. Chan-Yeung M., Enarson D., Grzybowski S. Grain dust and respiratory health. Can Med Assoc J. 1985 Nov; 133: 969-973.
11. Hosseinabadi M.B., Krozhdeh J., Khanjani N., Zamani A., Ranjbar M., Mohammadian M. Relationship between Lung Function and Flour Dust in Flour Factory Workers. Journal of Community Health Research. 2013; 2(2): 138-146. http://jhr.ssu.ac.ir
12. Kakooei H., Marioryad H. Exposure to Inhalable Flour Dust and Respiratory Symptoms of Workers in a Flour Mill in Iran. Iranian J Env Health Sci Eng. 2005; 2(1): 50-55.
13. Brisman J. Baker's Asthma. Occup Environ Med. 2002; 59(7): 498-502.
14. Baatjies R., Lopata A. L., Sander I., Raulf-Heimsoth M., Bateman E. D., Meijster T. Determinants of asthma phenotype in supermarket bakery workers. Eur Respir J. 2009; 34: 825-833.
15. American Lung Association. Lung Disease Data. Occupational Lung Disease; 2008: .p. 101-106. http://www.lung.org/assets/documents/publications/lung-disease-data/LDD_2008.pdf
16. Shravya K., Hari Krishna B., Suresh M., Mallikarjuna R. Effect of slow deep breathing (6 breaths/min) on pulmonary function in healthy volunteers. International Journal of Medical Research & Health Sciences, IJMRHS. 2013, July-Sept; 2(3): 597-602.
17. Meo S.A. Dose Responses of Years of Exposure on Lung Functions in Flour Mill Workers. Journal of Occupational Health. 2004; 46: 187-191.
18. Dhillon S. K. Effect of flour dust on lung volumes and capacities in flour mill workers. NJIRM. 2012, April-June; 3(2): 91-95.
19. Karim M. A., Rab M. O., Omer A. A., Haimi Y. A. Respiratory and allergic disorders in workers exposed to grain and flour dust. Arch Environ Health. 1986 Sept-Oct; 41(5): 297-301.
20. Nayak Y., Kacha Y., Mehta H., Shah C., Vegad A., Varu M. Effects of flour dust on computerized spirometric parameters in flour mill workers. International Journal of Basic and Applied Physiology, IJBAP. 2013 Dec; 2(1): 208-212.
21. Dhillon S.K., Kaur H. Study Of Effect Of Flour Dust And Rice Husk Dust On Pulmonary Functions. Indian Journal of Fundamental and Applied Life Sciences. 2011 Oct-Dec; 1(4): 100-106.
22. Mathur M. L., Dixit A. K. A study of Forced Vital Capacity and its predictors among the sand stone quarry workers. Indian J Physiol Pharmacol. 1999; 43(3): 347-354.
23. Kacmarek R. M., Stoller J. K. and Heuer A. J. Douce F. H. Chapter 19. Pulmonary Function Testing. In: Egan's Fundamentals of Respiratory Care. 10th Edition. St. Louis,Missouri. Mosby: 2013 .p. 417-450.
24. Wilkins R. L., Sheldon R. L. and Krider S. J. Chapter 8. Pulmonary Function Testing. In: Clinical Assessment in Respiratory Care. 5th Edition. St. Louis, Missouri. Mosby Inc.: 2005 .p. 141-164.
25. Rupple G. L. Chapter 2. Spirometry and Related Tests. In: Manual of Pulmonary Function Testing. 8th Edition. St. Louis, Missouri. Mosby: 2003 .p. 39-93.
26. Post W., Heederik D., Houba R. Decline in lung function related to exposure and selection processes among workers in the grain processing and animal feed industry. Occup Environ Med. 1998; 55: 349-355.
27. AlaEldin H. A., Ilham E. B., Merghani T. H. Effects of exposure to flour dust on respiratory symptoms and lung function of the bakery workers: a case control study. Sudanese Journal of Public Health. 2009 Jan.; 4(1): 210-213.
28. Frownfelter D., Dean E., Hammon III W. E. Part I- Cardiovascular and Pulmonary Function in Health and Disease. Chapter 5. Cardiopulmonary

Pathophysiology. In: Cardiovascular and Pulmonary Physical Therapy. Evidence and Practice. 4th Edition. St. Louis, Missouri. Mosby Inc. 2006. p. 85-114.
29. Ige O. M., Awoyemi O. B. Respiratory symptoms and ventilatory function of the bakery workers in Ibadan, Nigeria. West Afr J Med. 2002 Oct-Dec; 21(4): 316-8.
30. Hillegass E. A., Sadowsky H. S., Clough P Part 2. Pathophysiology. Chapter 5. Restrictive Lung Dysfunction. In: Essentials of Cardiopulmonary Physical Therapy. 2nd Edition. Philadelphia. W. B. Saunders Company, Elsevier. 2001. p. 183-255.

How to cite this article: Tawde PM, Kazi AH, Gunjal SB et. al. Effects of breathing exercise and preventive measure on pulmonary functions in flour mill workers. Int J Health Sci Res. 2015; 5(7):241-249.

****