International Journal of Research and Review
www.ijrrjournal.com E-ISSN: 2349-9788; P-ISSN: 2454-2237

Original Research Article

Prevalence of Respiratory Symptoms and Lung Function of Flour Mill Workers in Ilorin, North Central Nigeria

Abdulsalam Saliu Tosho[1], Abdus-salam Ismail Adeshina[2], Moshood Salawu[1], Arinde James Tope[1]

[1]Department of Community Medicine, Ladoke Akintola University of Technology Teaching Hospital, Ogbomoso, Oyo State, Nigeria.
[2]Directorate of Disease Control, Lagos State Ministry of Health, Alausa-Ikeja, Lagos, Nigeria

Corresponding author: Abdulsalam Saliu Tosho

Received: 15/02/2015 *Revised: 16/03/2015* *Accepted: 16/03/2015*

ABSTRACT

Flour mill workers are at increased risk of developing respiratory symptoms and reduced lung function indices due to exposure to dust in their working environment. The objective of this cross-sectional study was to assess the effects of flour dust on respiratory symptoms and lung function parameters in 101 flour mill workers and similar number of matched external controls using structured interview administered technique. Physical examinations were conducted; lung function indices measured and inspection of work-site environment was carried out. The comparisons of the arithmetic means were done using the student's t test. Statistical significance was put at $p<0.05$. Respiratory symptoms were significantly higher in the flour mill workers, 49.5% than the controls, and 27.7%. A significant reduction in the overall mean values of FVC, FEV1, PEFR and MVV were observed in the flour mill workers. The mean concentrations of TSP were 6.20±0.07 mg/m^3 and 4.25±0.03 mg/m^3 for study and control groups respectively. Exposure to flour dust causes increased work related respiratory symptoms and significant reduction in lung function parameters in flour mill workers. The study recommends periodic medical examination, continuous environmental monitoring and collaboration between regulatory agencies, health officials, mill management and flour mill workers.

Key words: Flour mill workers, flour dust, respiratory symptoms, lung function indices

INTRODUCTION

The global burden of diseases related to occupational factors was estimated at 4-10 million cases per year, with approximately 3-9 million in developing countries per year. [1] An estimated 12 percent of chronic obstructive airway diseases deaths are from occupational exposure to airborne particulates. Occupational diseases are caused by a pathogenic response of patients to their working environment and extended exposure to irritating or toxic substances that may cause acute or chronic respiratory ailments. [2] The respiratory health effects of variety of dusts on workers in small and large scale industries have been well documented. [3]

Flour dust is a hazardous substance with respiratory sensitizing properties which may give rise to respiratory, nasal and eye symptoms. [4] Flour mill workers have also

been reported to exhibit a variety of clinical manifestation including, impairment of lung function and chronic obstructive pulmonary disease. [5] The exposures to this inhalable dust do occur even in mills with the most up-to-date technology and proper cleaning procedures. [2] Spirometry is one of the most important diagnostic tools in the diagnosis and prognosis of respiratory diseases and describes the effects of restriction and obstruction on the lung function. [6] Lung function tests are beneficial in the early recognition of pulmonary dysfunctions even if the workers may well be normal clinically. [3,7] The diseases of the respiratory system induced by occupational dusts are influenced by the type of dust, dose, duration of exposure and genetic factors. [8,9]

In flour mills, dust generated are released into the air and later inhaled during industrial process, such as cleaning, crumbling, packing and shipping. [10] The level of dust exposure is highest in the mixing and packing sites of the flour mills. [11] When milling and packaging operations are running smoothly, personal exposures are largely a function of the background dust levels. [12]

The increasing industrialization and urbanization of Nigerian communities, has resulted into an attendant proliferation of fast food industries nationwide, creating an increased demand for wheat flour and its products. [13] Consequently, there has been an increase in the numbers of flour mill industries in the country, some of them employing as many as 500 workers. [14]

In Nigeria, various studies have shown the role of occupational exposure to environmental pollutants in the incidence of respiratory diseases in other occupational settings but very little attention has been paid to the health status of workers in the flour industry. [15-22] Consequently, there is still dearth of information about the effects of flour dust on respiratory systems and lung function parameters of flour mill workers in Nigeria. The most recent study done over 10 years ago reported on the respiratory effects of flour dust on flour mill workers but did not investigate their lung function parameters. [13] In other settings, cross-sectional epidemiological studies had shown a higher prevalence of respiratory symptoms among grain/flour handlers compared with workers not so unexposed, even after controlling for the effect of smoking [2,11,14] This study is therefore aimed at assessing the effects of flour dust on respiratory symptoms and lung function of flour mill workers in Ilorin, North Central Nigeria with a view to making recommendations for future intervention in the industry.

MATERIALS AND METHODS

The study was carried out between December 2013 and March 2014 in a flour mill in Ilorin, Kwara State, North Central Nigeria.

Study population

Two hundred and two respondents were selected from the flour mill workers and the control using systematic sampling technique. The study population was mainly 101 males out of the 288 engaged in flour milling operations in the factory while the 101 controls were drawn from workers in a nearby soap manufacturing company.

Study design

The study groups were suitably matched in terms of major demographic variables, all of which could confound the prevalence of symptoms of respiratory disease. The controls were never employed in a wheat flour mill or related industry. This study was a cross sectional analytical study carried out between December 2013 and March 2014 and the minimum sample size was obtained from a prevalence of 50.4% of report of at least one respiratory symptom among flour millers in previous

literature and assuming a 10% non response rate. [13]

Comprehensive lists of all the workers in the companies was obtained from the human resource departments and were used as sampling frames for the two groups. A sampling ratio of 1:3 was then obtained by dividing the sampling frame by the minimum sample size. Every third respondent was chosen from the list using a systematic sampling method. The females in the study and control groups were excluded from the study. The study and control groups were further matched for age (within a 5-year range), weight (within 1-kg range), and height (within 10-cm range) on a group basis using frequency-matching techniques. [23]

The study group was made up of milling, engineering, cleaning, packing and other warehouse personnel who experienced regular daily exposure. In addition, inspection of work-site environment was carried out with the help of a checklist adapted from previous work as a guide. [24] Dust concentrations in various sections of the flour mill were estimated in an attempt to relate clinical symptoms with particulate dust exposures. Duration of exposure to flour dust was divided into <5 years and >5years.

Exclusion criteria

Employees whose exposure was limited to grain dust, administrative and transport personnel who had possible intermittent exposure outside the production or packing areas, were excluded. Respondents from both study and controls with previous history of respiratory diseases and who had worked in dust-exposed occupations were also excluded. Similarly, in our estimation of the flour mill workers exposure to environmental dust, only samples where flour dust could be encountered by workers were included while the areas where grain dust exposure arose were specifically excluded.

Data collection tools and technique

Data was collected using a structured interviewer administered questionnaire adapted from previous studies. [25,26] Respondents were interviewed by trained resident doctors who filled the questionnaire. The questionnaire contained questions on respondents demographic attributes, reported respiratory symptoms, smoking status of the subjects and occupational history in relation to exposure. The work histories of the study subjects were assessed through questions on previous and current job, daily working time, job description, working conditions, and protective measures used.

Respiratory symptoms such as cough, sputum production, shortness of breath, wheeze and chest discomfort were referred to as work related symptoms. Symptoms were considered to be work-related if they improved over a weekend or holiday or if employees reported them to be provoked by contact with flour dust. The respondents with cough and sputum production during the day and night for up to 5 or more days per week were described as haven cough and sputum; those who perceived shortness of breath when walking with other people of same age on level ground or up a slight hill were considered to be breathless while chest pain/discomfort was described as feeling of tightness in the chest or difficulty in breathing on the first day back at work on more than 50% of occasions and/or on other days too. Wheeze was described as ability of subject or others nearby to hear a whistling sound when subject was breathing.

Respondents were questioned with regard to smoking cigarettes or other tobacco products or its chewing. Smoking index was divided into three grades by smoking degree (number of cigarettes

smoked daily multiplied by the number of smoking years) according to classification: mild smokers as smoking index less than 200; moderate smokers as smoking index of 200-400 and heavy smokers as smoking index more than 400. [27]

Physical Examination

Physical examination of all subjects including measurement of height and weight of all subjects were carried out on sites. Anthropometric measurements were done with the standing heights of respondents measured with potable Leicester® height stadiometer, graduated with respondents standing in an erect barefoot position, arms by side, and feet together with 0.1 cm precision. The body weights were measured with minimum clothing barefooted and without head coverings using a portable SECA Alpha® (Model 770) electronic weighing scale, placed on firm horizontal surface. The scale was graduated to measure up to 0.1kg with maximum weight of 150kg. The weighing scale was standardized by reference to an individual of known weight who was weighted each day on a standard hospital based scale just before calibration. The performance of the instruments were checked on each day and recalibrated if found necessary. Chest examination was carried out when indicated using standard medical examination procedures.

Spirometry

The lung function tests were carried out using portable electronic spirometer; Spirobank G®. The equipment was calibrated daily and operated within the ambient temperature range of 20-250C. The instrument was calibrated daily. The spirometer measured how much air was exhaled by subjects after maximal inspirations. The technique for performing the lung function tests were based on the manual operation of the instrument with special reference to approved standards. [28] All lung function indices measurements were done during the morning shift (9a.m.-1 p.m.) to minimise any diurnal variation and conducted on each subject in standing position at the sickbay of both the flour mill and the soap industry before entering the operational areas for shift work. The maneuver was explainned to each subject and demonstrated before measurement. The subjects were encouraged to practice this manoeuvre before performing the lung function tests. A disposable mouth piece was inserted into the mouth beyond the teeth and respondents asked to breathes in slowly as far as he could (without using a nose clip), they thereafter held their breath and then blows out with maximum effort and as fast as possible into the spirometer. The maneuver was repeated thrice after adequate rest. The average of the three readings was recorded. The lung function parameters as displayed by the spirometer which emmitted a continuous beep after six seconds of expiration by each subject were recorded for each subject.

The measured parameters were Forced Vital Capacity (FVC), calculated after subject has blown as hard and fast as possible into the spirometer and the Forced Expiratory Volume in 1 sec (FEV1) which was the volume of air breathed out in the first second of a forced expiration. The Forced Expiratory ratio (FEV1/FVC) %, Forced Expiratory Flow $_{25\text{-}75}$ ($FEF_{25\text{-}75}$) Peak Expiratory Flow Rate (PEFR) which measure air flow obstruction as recorded on the spirometer and Maximum Voluntary Ventilation (MVV) which is the greatest volume of air that can be expired per minute by voluntary effort.

Dust Measurement

The sampling of the environmental flour dust at the mill was conducted by the technical staff of Kwara State Ministry of Environment and Forestry. Total Suspended Particulate (TSP) samples were collected from each sampling location (production

and maintenance sections) on a 4-mm diameter membrane filter (What man Ltd., USA) with the use of a portable air sampler (Aerocet 531 Handheld Particulate Matter Monitor). In each case, the dust sampler was placed on raised platforms, but as close as possible to the vicinity and breathing zones of workers. The dust samples were further analyzed at the Department of Food Science and Technology, Ladoke Akintola University of Technology, Ogbomoso to confirm that they consisted of organic wheat flour material. The appearance of the stained granules of wheat was used to identify the particles under the microscope, and the shapes were compatible with that described for wheat. [29] The instruments also carried out Particulates Measurements (PM) with mass concentration ranges of PM_{10} at eight purposively selected areas of operation at each of the production and maintenance sections of the flour mill.

Data Management

The data entry and analysis was carried out using Statistical Package for Social Sciences (SPSS) Version 17. Results were presented descriptively as frequencies, proportions, percentages and mean (±Standard Deviation). The prevalence ratio was calculated in those study and controls. The association between selected risk factors and reported respiratory symptoms were measured using Chi square statistical test. The differences in mean age, height and weight of the study and control subjects were compared using student t-test (two tailed). In cases where the means were derived from a series of average measurements, as for dust levels, results were expressed as means (±Standard Error of the Mean). The level of statistical significance was established at a value of $p<0.05$.

Ethical Consideration

The respondents were assured of confidentiality and the benefits of the study were explained to them. The research protocol was approved by the Research and Ethics Committee of Ladoke Akintola University of Technology Teaching Hospital, Ogbomoso and written informed consent obtained from each subject prior to inclusion in the study.

Limitation

Basing prevalence of symptoms on perceived work-related symptoms by the respondents was considered a limitation to the study.

RESULTS

A total of 202 workers were included in this study. The 101 flour mill workers and 101 matched controls from the soap manufacturing company. Respondents were generally comparable in their socio-demographic characteristics (Table 1).

Anthropometric studies

Table 1: Socio-demographic characteristics of flour mill workers and control

Parameters	Mill workers n=101	Controls n=101	p-value
	Mean (SD)	Mean (SD)	
Age (yrs)	35.47 ± 8.8	39.53± 10.0	0.05
Height (cm)	167.60± 10.6	162.08± 9.9	0.07
Weight (kg)	69.75± 15.33	72.83±10.1	0.09
	n=101 (%)	n=101(%)	
Duration of Employment			
< 5 yrs	45 (44.6)	53(52.5)	0.09
>5yrs	56 (55.4)	48(47.5)	
Educational Level			
None	27 (26.7)	28 (27.7)	*0.02
Primary	1 (0.9)	9(8.9)	
Secondary	12(11.9)	16(15.8)	
Tertiary	37 (36.6)	24 (23.8)	
Smoking History			
Smokers			
Number (%)	52 (51.5)	25(24.8)	*0.00
Non-smokers			
Number (%)	6 (5.9)	33 (32.7)	*0.00
Smoking Index			
Mild (<200)			
Number (%)	3 (2.9)	4 (3.9)	0.74
Moderate (200-400)			
Number (%)	14 (13.9)	6 (5.9)	
Heavy (>400)			
Number (%)	35 (34.7)	15(14.9)	

SD=Standard Deviation * p<0.05

The age of the flour mill workers ranged between 18 and 57 years with a mean

of 35.47 (±8.78) while the age range of the control group ranged between 20 and 57 with a mean of 39.53 (±10.04) as shown in Table 1. There were no significant differences between the means of anthropometric parameters in terms of age, height and weight between the groups, p>0.05. The flour mill workers did not differ significantly from the control in smoking indices and duration of employment. The difference in the smoking history and educational levels of respondents in the flour mill workers and control were however statistically significant, p<0.05.

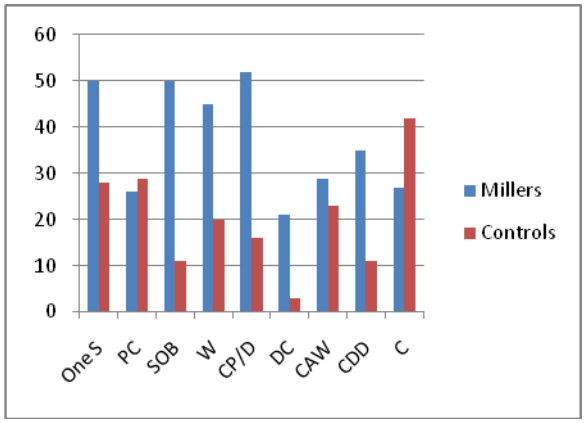

Fig. 1: Significant differences between flour mill workers and controls for respiratory symptoms
One S: One Symptom CP/D: Chest Pain/Discomfort C: Catarrh PC: Productive Cough DC: Dry Cough SOB: Shortness of Breath W: Wheeze CAW: Cough after Waking up CDD: Cough during the Day

Table 2: Prevalence of reported respiratory symptoms between mill workers and controls

	Mill workers	Control		
	n=101	n=101		
Symptoms	Freq. (%)	Freq. (%)	Prev. (Odd) Ratio	p-value
Report of at least one respiratory symptom	50 (49.5)	28 (27.7)	2.50	*0.001
Productive cough	26 (25.7)	29 (28.7)	0.07	0.635
Shortness of breath	50 (49.5)	11 (10.9)	0.05	*0.000
Wheeze	45(44.6)	20 (19.8)	0.09	*0.000
Chest Pain/discomfort	52 (51.5)	16 (15.8)	0.08	*0.000
Dry Cough	21 (20.8)	3 (3.0)	0.06	*0.000
Cough after waking up	29 (28.7)	23 (22.8)	0.07	0.334
Cough during the day	35 (34.7)	11 (10.9)	0.04	*0.000
Catarrh	27 (26.7)	42 (41.6)	0.11	*0.026

* p<0.05

Prevalence of respiratory symptoms

The prevalence of reported respiratory symptoms among the two groups is shown in Table 2and Figure 1. The flour mill workers had a significantly higher prevalence of respiratory symptoms compared to controls. Fifty respondents (49.5%) among the flour mill workers reported at least one respiratory symptom, compared with 28 (27.7%) among the control, P<0.05. The difference in prevalence of respiratory symptoms observed between the two groups was statistically significant for dry cough, shortness of breath, cough during the day, chest pain and catarrh. The likelihood of a flour mill worker developing at least one respiratory symptom was shown to be 0.75 times statistically significantly higher than that of a control worker.

Table 3: Comparison of respiratory signs of flour mill workers and controls

Parameters	Flour mill workers	Control	t	p-value
	Mean (SD)	Mean (SD)		
Respiratory Rate/min	20.83± 2.02	15.45± 1.23	1.31	0.002*
Signs	Freq. (%)	Freq. (%)	Prevalence ratio	p-value
	n=101	n=101		
Normal	70(69.3)	65(64.4)	1.25	0.455
Rhonchi	44(43.6)	24(24.0)	1.83	*0.003
Crepitations	9(8.9)	4(4.0)	2.40	0.147
Bronchial breath sounds	26(26.0)	14 (13.9)	2.15	*0.034

*p<0.05

Table 4: Prevalence of reported work-related respiratory symptoms among flour mill workers by selected risk factors

	n=101	Symptoms	
Risk factors	Freq.	Freq. (%)	p-value
Age (years)			
<40	54	45(83.3)	*0.00
>40	47	44 (93.6)	
Duration of employment			
<5years	45	44(97.8)	*0.00
>5 years	56	55(98.2)	
Smoking status			
Smokers	35	34 (97.1)	0.08
Non-smokers	66	65(98.5)	
Level of Exposure to flour dust			
Production section	81	80 (98.8)	0.12
Maintenance unit	20	19 (95.0)	

* p<0.05

Table 3 compared the respiratory signs of flour mill workers and controls on clinical examination. The flour mill workers had statistically significant higher mean respiratory rate, 20.83±2.02/min, compared to the controls, 15.45±1.23/min. Similarly, there were significant differences for wheeze, rhonchi and bronchial breath sounds, p<0.05.

Table 4 shows the prevalence of reported work-related respiratory symptoms and risk factors. Workers with age greater than 40 years reported a significantly higher prevalence of respiratory symptoms, 93.6%, than those age less than 40 years, 83.3%, p<0.05. Similarly, workers who had spent 5 years and above reported a significantly higher prevalence, 98.2%, than those with shorter duration, 97.8%, p<0.05.

Table 5: Comparison of lung function indices between flour mill and control subjects

	Flour mill Workers	Control		
Parameters	mean ±SEM	mean±SEM	t	p-value
	n=101	n=101		
FVC %	86.68±2.27	89.46±2.36	-0.849	0.01*
FEV1%	83.79±2.43	90.90±2.63	-1.984	0.048*
FEV1/FVC%	96.67±1.53	101.61±1.21	-2.831	0.080
PEF R (liters/min)	516.72± 38.48	575.37 ± 27.34	-3.687	0.000*
FEF_{25-75} %`	42.5	63.1	-6.500	0.050
MVV (liters/min)	120.04±3.56	97.63±4.71	-8.67	0.000*

%= percent of predicted values *p<0.05=significant

Lung Function Test

Table 5 shows that the mean respiratory function parameters (FVC, FEV1, FEV1/FVC, PEFR and MVV) in the flour mill workers were lower than the controls. The differences observed in these mean values were statistically significant for FVC, FEV1, PEFR and MVV, p<0.05. However, there were no significant differences observed between the two groups in respect to FEV1/FVC% and FEF $_{25-75\%}$. The mean PEFR values obtained for the flour mill workers (516.72l/min) and controls, 575.37l/min, were within normal limits though the flour mill workers had significantly lower PEFR values compared with controls, p<0.05

Table 6: Comparison of mean particulate matter concentrations in major work environment of Flour Mill Workers

Parameters	Production section	Maintenance unit	t	p-value
	Mean±SEM	Mean±SEM		
PM_{10} (mg/m^3)	0.28±0.05	0.17±0.02	2.10	0.05
TSP(mg/m^3)	6.20±0.07	4.25±0.03	2.42	0.03*

*p<0.05 TSP =Total Sample Particulate

Dust sampling

Table 6 shows that the mean PM_{10} and TSP measured in the production section was higher than the value recorded for maintenance unit. The TSP concentration at the production unit was statistically significantly higher compared with the maintenance unit (P<0.05). The mean values at both sites, however, exceeded the national standards of 0.25 mg/m^3. [30] Despite these

very high values neither the production or maintenance workers wore any dust protective devices. The significantly higher TSP concentration on the production section compared with the maintenance site was congruent with the higher prevalence of respiratory symptoms among production workers compared with those of maintenance unit.

DISCUSSION

There was no significant difference between the mean ages, heights of the flour mill workers and the controls. The flour mill workers are relatively younger than the control group. Previous studies found no association between the prevalence of respiratory symptoms and age. [31,32] The presence of respondents in the younger age group among the flour mill workers might be due to the computerization of the work processes in the factory which required computer literates' young professionals. There were significant differences between the two groups with respect to educational level and smoking habit but there was no significant difference in their smoking indices, $p<0.05$. On duration of employment, the study showed that workers with longer duration of employment reported a significantly higher prevalence of symptoms (98.2%) than those with shorter duration (97.8%), $p<0.05$. Duration of employment was found to be an important factor that influenced the prevalence of respiratory symptoms in a previous study. [3]

In this study all respiratory symptoms were significantly more prevalent among flour mill workers compared to the controls, $p<0.05$. In our study 49.5% of the flour mill workers reported at least one respiratory symptom compared with 27.7% in control subjects. This is in agreement with previous studies carried out on flour mill workers. [12,33] A prevalence of 54% was reported in flour mill workers compared to controls in Ibadan, South West Nigeria with significantly higher prevalence among flour mill workers. [13] The higher prevalence of respiratory symptoms in the flour mill workers might be due to the long time exposure and the non-utilization of personal protective devices by the workers. Similarly, it was also observed that the flour mill workers have an increased risk of developing respiratory symptoms compared to the controls. The most common respiratory symptoms in the study were chest pain 51%, breathlessness 49.5% and cough 34.7%. The same studies observed that flour dust exposure causes dry cough, productive cough, and decreased pulmonary function regardless of exposure to relatively low concentration levels of inspirable dust. In a study to determine the prevalence of respiratory symptoms in a group of workers from a United Kingdom flour milling industry, a prevalence of 22% for upper respiratory tract symptoms was reported. [12] The relationship between flour dust exposure levels and the respiratory health status of workers in flour mills was also described in a study in Eastern France. [34] In a case control study in Khartoum, Sudan, daily work related respiratory symptoms were significantly increased in cases compared with controls. [33] The significantly higher prevalence of respiratory symptoms observed among the flour mill workers in this study was similar to findings in other studies. [2,4,10,13,14,16,35,36]

A previous study on flour mill workers observed that they exhibit a variety of clinical manifestations. [8] In our study, rhonchi was diagnosed in 44 (43.6%) of the flour mill workers compare with 24 (24.0%) controls. A higher prevalence of bronchial breath sounds were diagnosed in flour mill workers 26 (26.0%) than in controls 14 (13.9%). Prevalence of crepitation was also higher in flour mill workers 9 (8.9%) compared to control, 4 (4.0%). All

associations were statistically significant (except crepitation), $p<0.05$(Table 3). However, there was no significant difference between the respiratory rates of the flour mill workers and the control group, $p>0.05$.

The results of the present study established a statistically significant reduction in the mean values of FVC%, FEV1%, MVV% and PEFR% in the flour workers as compared with controls, $p<0.05$ (Table 4). However, the decreased in FVC/FEV1 and FEF_{25-75} were not statistically significant, $p>0.05$. Other studies have shown that the impairment of respiratory function affects both FEV1 and FVC. [35,37,38] This study confirms the findings of others that flour dust adversely affects lung function parameters of flour mill relative to the controls. [2,9,14,33,34] A previous study showed no significant differences between the ventilator function test results of the flour mill workers and control subjects. [39] In an epidemiological survey of grain mill workers in Cape Town, South Africa, it was observed that the workers had significantly deteriorated lung function values compared to their matched controls. [37] In Nigeria, a study conducted in Ibadan reported that the mean values of FVC, FEV1, PEFR and FEV1/FVC in bakery workers were significantly lower than those of the controls subject. [13] Another Nigerian study recorded significantly lower mean lung function indices compared with control subjects. [16] The low FEV1 value may indicate obstructive lung diseases or reduction in lung volume. Previous studies reported that PEFR value was significantly reduced in flour mill workers as compared to their controls. [40-42] The PEFR provides an objective assessment of functional changes associated with environmental and occupational exposures and determine acute or chronic disease process. [43] The reduced PEFR value in our study might be due to exposure to flour dust and duration. The MVV reflects the function of the entire ventilator apparatus and depends upon the compliance of the thoracic wall and lungs, airway resistance and muscular force. [43] MVV is reduced in patients with airway obstruction or emphysema.

The work stations at the flour mill were generally filled with visible dust. The mean concentration of PM_{10} and TSP for the production was higher than that measured in the maintenance sections of the flour mill. This might be due to higher airborne particulate matter from flour dust during production processes. The mean values of the PM_{10} concentration in the production and maintenance sections were higher than the Nigerian standards of 0.25 mg/m3 and the 0.5 mg/m^3 of the American Conference of Governmental Industrial Hygienist. [24,25] Despite this, however, none of either flour mill workers or control wore any dust protective devices. As shown in Table 5, the workers in the production section were exposed to the highest concentration of dust, 6.20 mg/m^3 while the maintenance section had the lowest exposure 4.25 mg/m^3. Previous studies conducted in United Kingdom, Ibadan and Iran cited gave similar results. [6,12,38]

CONCLUSION AND RECOMMENDATIONS

The results of the present study showed that occupational exposure to flour dust could cause respiratory symptoms and significant reduction in the mean values of lung function indices such as FEV1, FVC PEFR and MVV. Results of area sampling of dust also revealed that average measurements exceeded the TLV and yet, a majority of the workers wore no dust protective de-vices. It could be concluded that the problem of effects of flour dust on the ventilator capacities of flour mill workers in Nigeria is of public health

importance hence the need to reduce exposures to the population at risk. These findings demonstrate the need to adopt technical preventive measures such as well ventilated working environment, work place hygiene, health education programs and wearing of appropriate respiratory protective devices.

Furthermore, the health risk to this group of workers should be reduced through mutual collaboration between regulatory agencies, health officials, mill management and the flour mill workers aimed at ensuring improvement in housekeeping and ventilation system with a view to reduce air contaminant levels. It is also suggested that flour mill workers must undergo pre-employment and periodic medical examinations so as to be able to identify susceptible workers. The programme should also include training and health education emphasizing the correct use of appropriate protective respiratory equipment. These measures are expected to prevent lung damage which will in turn reduce morbidity and mortality as a result of occupational lung diseases.

ACKNOWLEDGEMENTS

The authors are grateful to Dr (Mrs) Olugbenga-Bello O.I., the Head, Department of Community Medicine, Ladoke Akintola University of Technology Teching Hospital, Ogbomoso, Oyo State for her support and the flour mill workers for their participation.

Declarations

The authors declare that there is no conflict of interests regarding the publication of this paper.

REFERENCES

1. Theodore H, Tulychinsky, Elena A, Varakivoka. The new public health: An introduction for the 21st century. [Online]. 2014 [cited 2015 Jan 20]; Available from: URL:http://www.books.goggle.com.ng/books?isbn=012415767X; (5) page 289.
2. Karpinski EA. Exposure to inhalable flour dust in Canadian flour mills. Appl Occup. Environ. Hyg; 2003; 18:1022-30.
3. Mohammadien HA, Hussein MT, El-sokkary RT. Effects of exposure to flour dust on respiratory symptoms and pulmonary lung function of mill workers. Egyptian J of Chest Diseases and Tuberculosis. Oct. 2013: (62): 745-53.
4. Meo SA, Al-Drees AM. Lung function among non-smoking wheat flour mill workers. International Journal of Occupational Medicine and Environmental Health. 2005; 18(3): 25964.
5. Dosman JA, Graham BL, Cotton DJ. Chronic bronchitis and exposure to cereal grain dust. Am Rev Resp Disease. 1979; 120:477-80.
6. Ruppel GL. Pulmonary function testing Trends and technique. Resp Care Clinics N Am. 1977; 3:155-81.
7. Cotes JE. Lung Function Assessment and Application in Medicine. 4th ed. Oxford Edinburgh, Melbourne: Blackwell Scientific Publications, London. 1979.
8. Subbaro P, Mandhane MR, Sears RM. Asthma: Epidemiology, aetiology and risk factors. CMAJ. Oct 27, 2009; 181 (9): E181-E190.
9. Meo SA, Al-Drees AM. Lung function among non-smoking wheat flour mill workers. International Journal of Occupational Medicine and Environmental Health. 2005; 18(3): 25964.
10. Bachanek T, Chalas R, Pawlowicz A, Tarezydto B. Exposure to flour dust and the level of abrasion of hard tooth tissues among workers of flour mills. Ann Agric Environ Med. 1999; 6(2): 147-9.
11. Kolpp-Sarda SM, Massin N, Gobert B et al. Humoral immune responses of workers occupationally exposed to wheat flour. Am J. Ind. Med., 26(1994), 24-32.

12. Smith TA, ParkerG, Hussain T. Respiratory symptoms and wheat flour exposure: A study of flour millers. Occup Med. 2000; 50(1):25–29.
13. Ijadunola KT, Erhabor GE, Onayade AA, IjadunolaMY, Fatusi AO, Asuzu MC. Plumonary functions of wheat flour mill workers and controls in Ibadan. Nigeria. America J Ind Med 2005; 48(4):308-17.
14. Jinadu MK, Malomo MO. Investigations into occupational health problems of bakery workers in Ile-Ife, Nigeria. Nig Med Pract. 1986; 12(3/ 4):39–41.
15. Alakija W, Iyawe VI, Jarikre LN, Chiwuzie JC. Ventilatory function of workers at Okpella cement factory in Nigeria. West Afr J Med.1990. 9(3): 187-91.
16. Ige OM, Onadeko OB. 2000. Respiratory symptoms and ventilatory function of the saw millers in Ibadan, Nigeria.Afr J Med Sci. 2000; 29(2):101–104.
17. Okojie OH, Egbagbe E, Kadiri I. An epidemiological study of the health status of sawmills workers in Benin City, Edo State, Nigeria. J Med Biomed Res. J. 2003. 2 (1):76-81.
18. Okwari OO, Antai AB, Owu DU, Peters EJ, Osim EE. Lung function status of workers exposed to wood dust in timber markets Calabar, Nigeria. Afr J Med Sc. 2005; 34:141-45.
19. Ogakwu MAB. Pilot health survey among Enugu coal miners. Niger Med. J 1973; 3(2):97–99.
20. JinaduMK.. Pattern of disease and injury among road construction workers in Plateau and Bauchi areas, Northern Nigeria. Ann Trop Para. 1980; 74(6): 578–584.
21. Oleru U. 1980. Pulmonary functions of control and industrially exposed Nigerians in asbestos, textile, and toluene diisocyanate foam factories. Environ Res. 1980; 23:137–148.
22. Erhabor GE, Fatusi AO, Ndububa D. Pulmonary symptoms and functions in gas welders in Ile-Ife. Nig Med Pract. 1992; 24(5/6):99–101.
23. Abramson JH. Survey methods in community medicine. Edinburgh: Churchill and Livingstone. 1990.
24. Phoon WO. Practical occupational health. Singapore: PG Publishing. 1988; pp 157–158, 411–416.
25. Medical Research Council (MRC) Committee on the Aetiology of Chronic Bronchitis.. Standard questionnaire on respiratory symptoms. BMJ. 1960; 2:1665–1668.
26. Femi-Pearse D, Adeniyi-Jones A, Oke AB. 1973. Respiratory symptoms and their relationship to cigarette-smoking, dusty occupations, and domestic air pollution: Studies in random sample of an urban African population. The WAJM, June: 57–63.
27. Nitti V. Epidemiological survey of chronic obstructive pulmonary disease in the city of Naples with particular reference to the role of various exogenous factors. Bull Int Union Tuberc, 51 1976; p 10.
28. American Thoracic Society of Standardization of Spirometry. Am Rev Res Dis 1987; 136: 1286-96.
29. Pomeranz Y, Meloan CE. 1994. Food analysis: Theory and practice. New York: Chapman and Hall. pp 649–651.
30. Federal Environmental Protection Agency. 1991. Guidelines and standard for environmental protection control in Nigeria.
31. DoPico GA, Reddan W, Anderson S, Flaherty D. Acute effects of grain dust exposure during a work shift. Am Rev Resp Dis. 1983; 128: 399–404.
32. Chan-Yeung M, Schulzer M, Maclean L, Dorkhen E, Grzbowski S.. Epidemiologic health survey of grain elevator workers in British Columbia. Am Rev Respir Dis. 1980; 121:329–336.
33. Ahmed AH, Bilal IE, Merghani TH. Effect of exposure to flour dust on respiratory symptoms and lung function of bakery workers: a case control study.

Sudanese J. Pub. Health. 4 (1) (2009), pp. 210-13.
34. Masin N, Bohadana AB, Wild P, Kolopp-Sarda MN, Toamain JP. Airway responsiveness to methacholine, respiratory symptoms, and dust exposure levels in grain and flour mill workers in Eastern France.
35. Jeffrey P, Griffin P, Gibson M et al. Small bakeries-A cross sectional study of respiratory symptoms, sensitization and dust exposure. Occup. Med., 2011; 53: 417-22.
36. Bulat P, Myny K, Braeckman et al. Exposure to inhalable dust, wheat flour and alpha-amylase allergens in industria and traditional bakeries. Ann. Occp. Hyg. 2004; 48:57-63
37. Yach D, Myers J, Bradshaw D, Merriam JE. A respiratory epidemiological survey of grain mill workers in Cape Town, South Africa. Am. Rev. Respir. Dis., 131(1985) pp.9-19.
38. Ross DJ, Keynes HL, McDonald JC. Surveillance of work-related and occupational respiratory disease in the UK. Occup Med. 1997; 47:377-81.
39. Kakooei H, Marioryad H. Exposure to inhalable flour dust and respiratory symptoms of workers in a flour mill in Iran. Iran J Environ Health Sci Eng, 2 (1). 2005; p50-5.
40. Awad el Karim MA, Gad el Rab MO, Omer AA, el Haimi YA. Respiratory and allergic disorders in workers exposed to grain and flour dusts. Arch. Environ. Health. 1986; 41 (5): 297-301.
41. Ige OM, Awoyemi OB. Respiratory symptoms and ventilator function of the bakery workers in Ibadan, Nigeria. West Afr. J. Med., 2002; 21 (4): 316-18.
42. Zodpey SP, Tiwari RR. Peak expiratory flow rate in flour mill workers. Indian J Physiol. Pharmacolo.1988; 42 (4):521-26.
43. Quackenboss JJ, Lebowitz MD, Kryzanowski M. The normal range of diurnal changes in peak expiratory flow rate. Relationship to symptoms and pulmonary symptoms and respiratory disease. Am Rev Resp Dis. 1991; 143:323-30.

How to cite this article: Abdulsalam ST, Adeshina AI, Salawu M et. al. Prevalence of respiratory symptoms and lung function of flour mill workers in Ilorin, north central Nigeria. Int J Res Rev. 2015; 2(3):55-66.

****