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Pulmonary Functions and Respiratory Symptoms of Wheat Flour Mill Workers in The Duhok District

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Abstract

Exposure to flour dust in flour mill factories may cause diverse lung diseases with different severity of symptoms ranging from simple irritation to allergic rhinitis or occupational asthma; long-term exposure to flour dust can cause chronic lung problems. The aim of this study is to examine the effect of exposure to flour dust on the respiratory system and pulmonary function of wheat flour mill workers in the Duhok district. A cross-sectional study was performed among 63 workers who had direct contact with wheat flour mills. The data were collected using a well-structured questionnaire, anthropometric measurements, and digital spirometry. The workers' mean age ± (SD) was 29.79 ± 10.60 years. The current study showed the predicted Forced vital capacity (FVC) mean ± (SD) 105.34 L (±) 25.96 L, and the predicted Forced expiratory volume in one second (FEV1) mean ± (SD) 97.90 L (±) 18.65 L, and the predicted FEV1/FVC mean ± (SD) 95.82 L (±) 17.61 L. About 43(68.3%) of workers were normal,10(15.9%) had mild pulmonary obstruction followed by moderate restriction, 5(7.9%), and 3(4.8%) had mild pulmonary restriction. The mild obstructive disorder is more among normal Body Mass Index (BMI) persons, while restrictive disorders are more among overweight workers. This study showed no significant statistical association between PFTs and respiratory symptoms (sneezing, rhinorrhea, change of voice, dyspnea and cough), BMI, and the duration of working in the wheat flour mills.

Keywords: *Wheat Flour Mills Workers, Duhok District, Pulmonary Functions Tests.*

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I. INTRODUCTION

Flour dust is an asthma gene known to cause sensitisation, allergic rhinitis, and occupational asthma in bakers, millers, and sweet factory workers. The dust formed during cleaning, grinding, packaging, and transport is released into the air and can be inhaled. Exposure to flour dust and related enzymes is one of the most common causes of allergic rhinitis, chronic respiratory disorders including asthma, and occupational airway diseases. Flour dust and related enzymes can also act as an irritant, causing short-term respiratory, nasal, and eye symptoms or triggering an asthma attack in individuals with a preexisting condition (Elms *et al*., 2005; Hosseinabadi *et al*., 2013).

Occupational lung diseases are a set of illnesses produced by frequent, prolonged exposure or single, severe exposure to irritating or poisonous substances, which results in acute or chronic respiratory diseases. There is emerging consensus on the harmful effects of organic dust on industrial workers' respiratory symptoms and functions. Numerous studies have demonstrated that exposure to flour dust promotes respiratory symptoms and affects lung function, influencing lung health (Said *et al*., 2017).

Lung conditions are categorised as obstructive, restrictive, or mixed types. Spirometry is one of the most vital diagnostic techniques for occupational respiratory disorders. Spirometry plays a crucial role in diagnosing and prognosis of many diseases, as it demonstrates the impact of limitation or blockage on lung function (Hosseinabadi *et al*., 2013). Melo *et al.* (2016) found that Workers in wheat flour mills are more likely to develop lung function abnormalities, the most common of which is reversible airflow obstruction. Therefore, workers should be educated on the dangers of flour dust, advised to wear personal protective equipment, encouraged to make engineering and ventilation improvements, and urged to undergo periodic examinations. These procedures can significantly reduce the likelihood of irreversible airflow blockage. Ijadunola *et al.* (2005) concluded that in flour mills for wheat, Compared to control patients, Nigerian workers have a higher risk of having impaired lung function, with airway blockage being the most common pattern of respiratory disease. This study was

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selected due to the lack of previous studies in our region regarding the effect of exposure to Flour dust on the pulmonary function tests of the mills. The study aims to examine the effect of exposure to flour dust on the pulmonary functions of the workers in mill factories in the Duhok district.

II. Materials And Methods

A. Design of the study

A cross-sectional study was designed to fulfil the aim and objectives of this study.

B. Time of the study

Data collection was done from October 15th, 2021, to December 31st, 2021.

C. Setting of the study

The study was conducted in flour mills in the Duhok district.

D. Sample size and sampling methods

All flour mills in the Duhok district were included in this study. All people who work in flour Mills workers who have direct contact with flour dust will participate in the study. Some staff, such as administrative staff and others without connection to work in the flour mills were excluded. Also those refuse to conduct a study and those absent from work for any reason.

E. Data collection method

To facilitate the study process at the flour mills, the researcher introduced himself and gave a summary description of the study with the primary objective and objectives assigned to workers. Afterwards, the researcher explained each paragraph (questions) in Arabic and Kurdish (where the questionnaire was written in English); the researcher then filled out the questionnaire through a personal interview. After completing the form, the researcher examined the workers using a lung function test device.

The prepared questionnaire consists of 7 paragraphs and (questions), and the questions focused on the study's objectives and were divided into several sections. The questionnaire was adopted from two studies, the first was conducted on workers through a personal interview, and a lung function test device was conducted on the second.

i. Personal information: It included gathering information on age, gender, marital status, residency, and educational level.

ii. Occupational history: occupational history is divided into two parts: the current occupation and the previous occupation. Each of them is divided into some questions.

1. The current job in which field do you work and the length of work in years and are you exposed to wheat dust through work, working hours during the day and working days during the week, and direct working hours exposed to wheat dust.

2-The previous job was to work for years, and are you exposed to wheat dust through work and working hours that are exposed to wheat dust?

iii- Lifestyle Data: are your cigarettes smoked, and the answer is yes or no, the duration of smoking is in years, and the number of cigarettes smoked during the day? As for the water pipe, do you smoke the water pipe, and the answer is yes or no, the period of smoking the water pipe is in years and the number of times of smoke during the week.

Iv-Respiratory symptoms: 1-Upper respiratory symptoms are you have sneezed, Rhinorrhea Change of voice (the answers consist of two answers; yes and no).

2-Lower respiratory symptoms are Chest Wheeze Shortness of Breathing (SOB) (the answers consist of two answers; yes, and no).

3-Cough are you have a cough? The answer consists of yes or no, duration of cough if your cough is less than three weeks or more if more than three weeks have sputum, the color of sputum, and how many attacks per day.

v-Are you complaining of any chronic disease? Chest infections, Pulmonary tuberculosis, Chronic obstructive pulmonary disease (COPD), Cardiac disease, and Diabetes Mellitus. (The answer consists of yes or no).

vi-Safety and security equipment: Are you wearing at work any of them? Face mask, Protective glasses, Gloves, and Head cover (The answer is yes or no.)

Instruments Used in the Study

i-Measuring weight using an electronic scale (Uniscale-Secca 874)- Mobile flat scales for mobile use with push buttons and a dual display. The double display lets the person and medical personnel simultaneously read the results from two different prospects. The Height was measured by using a special device, Adult Height Measuring Device (Microtoise) {UNICEF Height measuring instrument (0-2 m)}.

Body mass index was calculated as the weight in kilograms divided by the height in meters squared.

BMI=weight (kg)/ [height (m)] 2

The BMI for each worker was determined using an international standardised chart according to WHO classification (Weir and Jan, 2022).

Underweight	BMI < 18.5
Healthy weight	BMI between 18.5 – 24.9
Overweight	BMI between 25 – 29.9
Obese	BMI 30 and above

ii-Spirometry (electronic spirometry).

A spirometer is a device that measures how much air enters and exits a person's lungs. The gadget can diagnose and monitor respiratory illnesses like asthma and Chronic Obstructive Pulmonary Diseases. It is a device that measures the air the lungs inhale and exhale. Air passage into and out of the lungs is measured with a spirometer. The spirogram will reveal two forms of aberrant ventilation patterns:

restrictive (mild, moderate and severe) and observative (mild, moderate and severe). A spirometer that can measure numerous components and aspects of your pulmonary function parameter should be used to provide the results, which should include graphs of volume-time and flow-volume superimposing all efforts and a clear table of results showing the following values:

- (Forced vital capacity) FVC: The total volume of air that can be forcibly exhaled in one breath.
- (Forced expiratory volume in one second) FEV1: The air volume expired in the 1st second of the blow.
- (Forced expiratory volume in one second divided by Forced vital capacity) FEV1/FVC: The fraction of air exhaled in the first second relative to the total volume exhaled.
- Diagnosis:(mild, moderate, severe) restrictive or obstructive, mixed restrictive and obstructive, in addition to the routine diagnosis.

Methods of grading the severity of obstructive and restrictive disorders (Altalag *et al*., 2019).

(A) ATS grading of severity of any spirometric abnormality based on FEV1

After determining the pattern to be obstructive, restrictive or mixed, FEV1 is used to grade severity:

Mild	FEV1 > 70 (% pred.)
Moderate	60–69
Moderately severe	50–59
Severe	35–49
Very severe	<35

(B) Grading the severity of obstructive and restrictive disorders

Mild	80–100
Moderate	50–79
Severe	30–49
Very severe	<30

Restrictive disorder (based on FVC, in case no lung volume study is available)

Mild	FVC >70 (% pred.)
Moderate	60–69
Moderately severe	50–59
Severe	35–49
Very severe	< 35

F. Pilot study

To test the prepared questionnaire, a pilot survey of several workers in two factories was conducted before the study to evaluate the feasibility and application of the questionnaire. After the pilot study was conducted, minor changes were made to the questionnaire.

G. Ethical considerations

The study protocols were approved and reviewed by the College of Health and Medical Technology's scientific committee at Shekhan / Duhok Polytechnic University. At the same time, it was approved by the Research Ethical Committee of the Directorate General of Health in Duhok Governorate/ directorate of planning approved the study protocol with Reference numbers: 16-18 of August 2021.

H. Statistical analysis

Descriptive and inferential statistics were used through the Microsoft Excel database alongside the Statistical Package for Social Sciences (SPSS software version 25.0 IBM SPSS, Armonk, NY: IBM Corp). The Chi-square test was used to determine the significant relationships between the variables. The P- value ≤ 0.05 is considered statistically significant.

III. RESULTS

A. Socio-demographic distribution of the study samples

Table 1 shows the mean age ± (SD) 29.79 years (±) 10.60 years, and up to 42% of the studied in the third decade. About half of the workers are primary school graduates, and more than 52% of workers are single

Table 1. Demographic characteristics of the study sample.

Variables	Frequency	Percentage
Age in years (mean age 29.79 years)		
< years	10	15.9
20-29 years	27	42.8
30-39 years	13	20.5
40-49 years	8	12.7
50 years and above	5	7.9
Educational Level		
Illiterate	4	6.3
read and write	1	1.6
primary school	30	47.6
intermediate school	10	15.9
high school	11	17.5
Institution	2	3.2
College	5	7.9
Marital Status		
Single	33	52.4
Married	30	47.6

The workers are classified according to their jobs 49 % (31) as manual workers, 32 % (32) as cleaners, and 19 % (11) packing the products.

B. Pulmonary function tests (PFTs)

The current study showed the predicted FVC mean ± (SD) 105.34 L (±) 25.96 L, the predicted FEV1 mean ± (SD) 97.90 L (±) 18.65 L, and the predicted FEV1/FVC mean ± (SD) 95.82 L (±) 17.61 L. About 43(68.3%) of workers were normal,10(15.9%) had mild pulmonary obstruction followed by moderate restriction, 5(7.9%), and 3(4.8%) had mild pulmonary restriction.

C. Distribution of workers according to PFTs and current job

Table 2. Shows that most of the workers (68.3%) are normal, while 15.9% had mild obstructive, 3.2% moderate obstructive, 4.8% mild restrictive and 7.9% moderate restrictive. There is no significant statistical association between PFTs and the current job type.

Table 2. Distribution of workers according to PFTs and current job

PFTs	Current job			
	Manual worker n (%)	Packing n (%)	Cleaner n (%)	Total n (%)
Normal	21(33.3)	7(11.1)	15(23.8)	43(68.3)
Mild Obstructive	4(6.3)	2(3.2)	4(6.3)	10(15.8)
moderate obstructive	2(3.2)	0(0)	0(0)	2(3.2)
Mild restrictive	1(1.6)	2(3.2)	0(0)	3(4.8)
moderate restrictive	3(4.8)	1(1.6)	1(1.6)	5(7.9)
Grand Total	31(49.2)	12(19.0)	20(31.7)	63(100.0)

P. value =0.455

D. PFTs and the length of time spent in the current profession

As shown in table 3, there is no significant statistical association between PFTs and the length of the working duration. Cases of mild obstructive disorders may occur after 3-9 years of work, while moderate destructive occurs after 3-6 years.

Table 3. The length of time spent in the current profession and PFTs

Time spent in the current profession	PFTs					
	Normal n (%)	Mild Obstructive n (%)	moderate obstructive n (%)	Mild restrictive n (%)	moderate restrictive n (%)	Total n (%)
less than three years	16(25.4)	3(4.8)	0(0)	1(1.6)	1(1.6)	21(33.3)
3 -6 years	13(20.6)	1(1.6)	2(3.2)	1(1.6)	2(3.2)	19(30.2)
6 -9 years	7(11.1)	4(6.4)	0(0)	1(1.6)	1(1.6)	13(20.7)
9 -12years	4(6.3)	1(1.6)	0(0)	0(0)	1(1.6)	6(9.5)
12 years and above	3(4.8)	1(1.6)	0(0)	0(0)	0(0)	4(6.3)
Grand Total	43(68.2)	10(15.9)	2(3.2)	3(4.8)	5(7.9)	63(100)

P. value =0.369

E. Distribution of study samples by BMI and PFTs

Table 4 shows that mild obstructive disorder is more among normal BMI persons, while restrictive conditions are more among overweight workers. There is no significant statistical association between PFTs and BMI of the working duration.

Table 4. Distribution of study samples by BMI and PFTs

BMI	PFTs					
	Normal n (%)	Mild Obstructive n (%)	Moderate obstructive n (%)	Mild restrictive n (%)	Moderate restrictive n (%)	Total n (%)
<18.5	2(3.2)	0(0)	0(0)	0(0)	0(0)	2(3.2)
18.5-24.9	23(36.5)	5(7.9)	1(1.6)	0(0)	2(3.2)	31(49.2)
25-29.9	10(15.8)	2(3.2)	1(1.6)	2(3.2)	3(4.7)	18(28.5)
30 and above	8(12.7)	3(4.8)	0(0)	1(1.6)	0(0)	12(19.1)
Grand Total	43(68.2)	10(15.9)	2(3.2)	3(4.8)	5(7.9)	63(100)

P. value =0.686

F. Distribution of study samples by Symptoms and signs and PFTs

Table 5 shows that 25 % of workers had to sneeze, 20.6% had rhinorrhea, 12.7% had a change of voice, 20.6% had chest wheeze, 28.6% had dyspnea, and 9.5% had dyspnea. There is no significant statistical association between PFTs and respiratory symptoms (sneezing, rhinorrhea, change of voice, dyspnea and cough).

IV. Discussion

The mean age of our study sample was 29.79 (±) 10.60 years is younger than a study done by Ijadunola *et al.* (2005), 34.3 ± 8.8 years, and also younger than the study done by Lagiso *et al*. (2020a) found that the mean age of 196 workers in 54 flour mill factories in Hawassa city, southern Ethiopia was 32.1 ± 9.99 years, on the other hand, 19.9% of his study sample were females while all workers in our sample study were males. This may be related to social and cultural factors in our community that don't encourage females to work in complex factory jobs.

Regarding the job distribution, most of this study sample were manual workers included in the mixing process. The current study shows that (49%) of the participants had the most significant percentage of manual workers, which may be near to Lagiso *et al*. (2020a), who found that up to 54% of his sample study was manual workers.

In this study, (3.2%) of the workers' BMI was within less than normal weight, (49.2%) of them were within the normal weight range, (28.6%) of them were overweight, (and 19%) of them were obese. The current study agreement with the study carried out in Egypt by Said *et al.* (2017) found that about 30 participants (50%) were regular, (30%) were overweight, and (20%) were obese, which is similar to the current study. The study disagreement with a study carried out by Mekonnen *et al*. (2021) was founded that the distribution of BMI of 280 participants (6.1%) was underweight, (83.9%), normal and (10%) overweight, but the result same in underweight only.

Table 5. Distribution of study samples by symptoms and signs and PFTs

Symptoms and signs		Pulmonary Function Tests						P. value
		Normal n (%)	Mild Obstructive n (%)	moderate obstructive n (%)	Mild restrictive n (%)	moderate restrictive n (%)	Total n (%)	
Sneezing	Yes (No). (%)	16 (25.4)	5 (7.9)	1 (1.6)	2 (3.2)	1 (1.6)	25 (39.7)	0.669
	No n (%)	27 (42.9)	5 (7.9)	1 (1.6)	1 (1.6)	4 (6.3)	38 (60.3)	
	Total n (%)	43 (68.3)	10 (15.8)	2 (3.2)	3(4.8)	5 (7.9)	63 (100)	
Rhinorrhea	Yes n (%)	6 (9.5)	5 (7.9)	1 (1.6)	0 (0.0)	1 (1.6)	13(20.6)	0.082
	No n (%)	37 (58.8)	5 (7.9)	1 (1.6)	3 (4.8)	4 (6.3)	50 (79.4)	
Change of voice	Yes n (%)	3 (4.8)	2 (3.2)	1 (1.6)	1 (1.6)	1 (1.6)	8 (12.8)	0.227
	No n (%)	40 (63.4)	8 (12.7)	1 (1.6)	2 (3.2)	4 (6.3)	55 (87.2)	
Chest wheeze	Yes n (%)	7 (11.1)	3 (4.8)	1 (1.6)	2 (3.2)	0 (0.0)	13 (20.7)	0.122
	No n (%)	36 (57.1)	7 (11.1)	1 (1.6)	1 (1.6)	5 (7.9)	50 (79.3)	
Dyspnea	Yes n (%)	11 (17.5)	5 (7.9)	1 (1.6)	1 (1.6)	0 (0.0)	18 (28.6)	0.295
	No n (%)	32 (50.8)	5 (7.9)	1 (1.6)	12 (3.2)	5 (7.9)	45 (71.4)	
Cough	Yes n (%)	3 (4.8)	1 (1.6)	0 (0.0)	1 (1.6)	1 (1.6)	6 (9.6)	0.533
	No n (%)	40 (63.4)	9 (14.3)	2 (3.2)	2 (3.2)	4 (6.3)	57 (90.4)	

The current study showed that exposure to flour dust in mill workers in the Duhok district is associated with increased respiratory symptoms and impairment of lung function. However, this study showed the data reveals that a large number of flour mill workers had problems with Sneezing (39.7%), dyspnea (28.6%), and chest wheezing (20.6%). This study found a significant association between work-related respiratory disorders and flour dust. Mohammadien *et al*. (2013) showed a similar result, dyspnea (26%). They were sneezing (%34) and chest wheezing (23%). This study disagreed with previous studies but was similar to dyspnea; the previous research found a significant association between work-related respiratory disorders and flour dust. The study funded dyspnea (30.11%). Chest wheezing (34.7%) (Gholami *et al*., 2018).

The current study agrees with the previous study. There was found to be a strong relation between flour dust, and respiratory disorder found (15.8%) have dyspnea, and (10.5%) have wheezing. But the result is different because the researchers think that there are a small number of participants in the study (Rafiee-pour *et al*., 2015)

Lagiso *et al*. (2020b) showed that the prevalence of almost all chronic respiratory symptoms was higher among flour mill factory workers, which agrees with the current study. This study was designed to analyse lung function abnormalities in flour workers using spirometry (electronic spirometry). Our research, showing a total of 63 workers investigated PFT (68.3%) were normal, and (31.7%) found PFT impairment, (15.9%) had mild pulmonary obstruction followed by moderate restriction 7.9%) finally (4.8%) had mild pulmonary restriction. The current study agreement with study these findings have been found in the previous studies carried out in India by Melo *et al*. (2016); a total of 40 workers (75%) were normal, and (25%) found a decrease in lung function (12.5%) had mild pulmonary obstruction, (2.5%) had moderate obstructive, 5(12.5%) had mild restriction, (5.5%) had moderate pulmonary restriction (Melo *et al*., 2016). This study agrees with a Previous study carried out in Egypt, which found that a total of 30 workers (83.3%) were normal, (10%) were Obstructive, and (3.3%) were Restrictive (Mohammed *et al*., 2017).

This study showed (that 31.7%) of the workers have lung function abnormalities; the study agreement with a previous study carried out on wheat flour mill workers and controls in Ibadan, Nigeria, which found (that 29%) had abnormal spirometry results (Ijadunola *et al*., 2005). The current study showed that The FVC mean ± (SD) 105.34 L (±) 25.96 L, the FEV1 mean ± (SD) 97.90 L (±) 18.65 L. The FEV1/FVC mean ± (SD) 95.82 L (±) 17.61 L. the results are similar to a study carried out among workers of flour mills in Addis Ababa, Ethiopia it was found that The FVC mean ± (SD) 88.59 L (±) 19.05 L, the FEV1 mean ± (SD) 87.80 L (±) 20.47 L, and The FEV1/FVC indicate ± (SD) 98.56 L (±) 15.99 L (Demeke *et al*., 2018).

Study limitations

Some mills did not operate for a while, so the researcher waited a long period until they started their work. There were difficulties during the interview. Some factories set the wrong times for the worker's interviews. However, the researcher conducted the interview and PPTS. No, study obstacles were detected in the study design or the sampling procedure as all wheat mills factories were included in this study.

V. CONCLUSION

Flour dust has a significant impact on human health, especially on diseases related to the respiratory system. This study showed that flour dust increases upper and lower respiratory symptoms. The mild obstructive disorder is more among normal Body Mass Index (BMI) persons, while restrictive disorders are more among overweight workers. This study showed no significant statistical association between PFTs and respiratory symptoms (sneezing, rhinorrhea, change of voice, dyspnea and cough), BMI, and the duration of working in the wheat flour mills.

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