

## Diagnosis of Occupational Asthma in Flour Mills at South Cairo

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### Abstract

**Introduction:** Occupational asthma is an international problem affecting large number of workers. Few studies were done on occupational asthma in Egypt focusing mainly on asthma symptoms and not on spirometric tests. **Objective:** The present study investigated the presence of occupational asthma (OA) among workers at flour mills of south Cairo as there was a lack of data. **Methods:** The participants (n=120) were recruited from flour mills at South Cairo. A questionnaire, clinical examination, chest x-ray, spirometry, bronchodilator test and peak flow rate variability test were done. Occupational asthma was diagnosed according to GINA guidelines. **Results:** This study showed that 25% of mills workers had asthma related to work. The asthma symptoms appeared during work which showed improvement after leaving workplace. It showed also reversibility in FEV<sub>1</sub>, PEF<sub>R</sub> as well as diurnal PEF<sub>R</sub> variability characteristics of occupational asthma. It revealed also that asthmatic workers had lower level of spirometric parameters in relation to non-asthmatic. **Conclusion:** Asthma questionnaire followed by ventilatory function test assessing reversibility and variability can be used for early diagnosis of occupational asthma in Egypt.

**Keywords:** bronchial reversibility and variability; Flour dusts; Bronchodilator test; occupational asthma

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### Introduction:

Bronchial asthma is an important widely spread public health problem affecting around 300 million persons all over the world with high degree of mortality and morbidity<sup>1</sup>. All countries whatever their socioeconomic states are suffering. Asthma affects people at all age group. When it is uncontrolled it can place severe limits on daily life and is sometimes fatal.<sup>2</sup> It was found that host factors and environmental factors play a role in asthma development. Host factors are: genetic predisposition to atopy, obesity and sex while environmental factors include: allergens either indoor or outdoor,

infections, tobacco smoke, air pollution and occupational sensitizers.<sup>3</sup>

Bronchial Asthma is characterized by a two or more of the following symptoms: wheeze, cough, shortness of breath and chest tightness. These symptoms worse at late night or in the early morning as well as vary over time and in intensity. They are also triggered by viral infections (colds), exercise, allergen exposure, changes in weather, laughter or irritants such as car exhaust fumes, smoke or strong smells<sup>4</sup>

The beginning of the following respiratory symptoms since childhood as well as past history of allergic rhinitis or eczema, or a family history of asthma or allergy,

increases the possibility of bronchial asthma<sup>5</sup>Physical examination in asthmatics is usually normal. Expiratory wheezing (rhonchi) is the most frequent abnormality heard by stethoscope.<sup>4,5</sup>

Pulmonary function tests are used to confirm asthma diagnosis and assessing its severity Lung Function varies in magnitude over time to a greater extent than in Healthy populations. It ranging from normal to severe reduced levels according to asthma severity. this variability is more seen in poorly controlled asthma.<sup>6</sup>

Occupational sensitizers is considered one of the commonest environmental agents causing occupational asthma affecting around 10% of working adults in the world Nicholson et al.2005<sup>15</sup> It is a special type of Bronchial asthma defined as "variable airway obstruction causally related to the exposure to a specific compound in the workplace".(GINA.2011)<sup>2</sup>The diagnosis of OA requires a defined history of occupational exposure to an established or suspected sensitizing agents in the workplace .in occupational asthma, a latent period of at least one year should be present between the beginning of work and the appearance of asthma symptoms. A clear relationship should be present between asthma symptoms and the workplace in the form of: appearance of asthma symptoms at work or early night after returning home. It worsens at early night before sleep and improve or disappear completely at late night or early morning on awakening. OA shows diurnal improvement of symptoms in contradictory to the ordinary bronchial asthma.Also there is improvement of asthma away from work in the weekend and holidays and worsening of symptoms on returning to work showing weekly variability.<sup>7</sup> Physical examination is usually normal like bronchial asthma so we

refer to spirometry to confirm the diagnosis especially reversibility and variability tests.<sup>4</sup>

Occupational asthma is common among in two mills workers due to exposure to organic dust full of allergens either from the grain components itself or from contaminants like insects, bacteria, endotoxins, molds, fungi, mites.<sup>8</sup>The aim of the study is to explore the prevalence of occupational asthma among flour mills at south Cairo as there is no available data of confirmed diagnosis using bronchodilator and variability test.

## Methods

*Study design and population:*The study was conducted as a cross-sectional study in two mills at South Cairo ((El-Sherouk and El-Tebbin). Both mills were aside. All workers in both mills were recruited (n=120) at the outpatient clinic of both mills. The workers were all males from different departments (grinding, packing, storage and garbling).

The study includes a questionnaire, clinical examination, chest x-ray and spirometry. An interview questionnaire: Asthma and respiratory symptoms, Chest examination for rhonchi, breath sound intensity and any other findings, chest X-ray were obtained from the records of the workers at the mills to exclude other chest diseases. Spirometry was done for all participants using portable spirometer (Mir spirolab 2) according to GINA guidelines 2011<sup>2</sup>, 2014<sup>9</sup>. Participants were asked to perform forced expiratory maneuver where three reproducible curves were obtained ( $\pm 5\%$ ).the spirometry was done from 8-11 am.The measured parameters included forced vital capacity(FVC),forced Expiratory volume in 1 second( FEV1), forced expiratory volume Ratio (FEV1%) and peak Expiratory flow rate(PEFR).

Bronchodilator test: The test was done for all participants regardless of asthma

history or initial spirometric values. Each participant was given salbutamol inhalation buff at a dose of 400 µg and left for 15 minutes. Then a post-bronchodilator spirometric measurement was done for the participants. An improvement in percent predicted FEV1 (pp FEV1) after bronchodilator inhalation  $>12$  GINA, 2011<sup>2</sup> and GINA 2014<sup>4</sup> or in PEFr percent predicted (pp PEFr)  $\geq 20\%$  (GINA, 2011)<sup>2</sup> is considered bronchial reversibility which confirm the diagnosis of bronchial asthma if present.

**PEFR Variability test:** The test was done for all participants at the outpatient clinic regardless of asthma history or initial spirometric values. The nocturnal PEFr was performed after 12 hours from the previous spirometric tests (from 8-11pm). The difference between the diurnal and nocturnal (pp PEFr) was also calculated to measure PEFr Variability. A drop in the nocturnal (pp PEFr) greater than 20% in a symptomatic person as well as with a positive bronchial reversibility is considered occupational asthma.

**Statistics:** Age, Body Mass Index, smoking index, duration of exposure length of employment and spirometric parameters, are expressed as mean  $\pm$  SD, minimum, maximum. Comparison between the pulmonary functions has been performed by means of McNemar test for categorical and continuous variables respectively. A p value lower than 0.05 was considered as statistically significant.

**Ethical consideration:** Approval of the study protocol was obtained from the Ethical committee at the faculty of Medicine, Ain Shams University. Informed consent was obtained from each participant before enrolment and after explanation of the study objectives.

## Results

Table (1) shows that the mean age of the participants was  $49 \pm 5.6$  [37-59] years

with mean duration of exposure  $27.4 \pm 5.1$  [20-40] years. Smoking was found in 61.7% of the workers. Table (2) shows the Clinical findings among participant workers which were in the form of: (28.3%) of them had recurrent RTI and asthma symptoms related to triggers (25.8%) like cold, irritants, laugh, and work. These symptoms resolve completely after awaking in 24 (20.0%) and partially in 6 (5.0%). Most of the asthma symptoms were in the form of Episodic chest tightness (25.8%), Episodic cough (23.3%) and Episodic dyspnea (22.5%). This table shows also that small number of workers suffer from Chronic dyspnea (11.7%) and cough (5.8%). (8.1%) persons had abnormal chest examination and x ray characteristics of COPD. Table (3) shows the % pred FVC was impaired in 41 (34.2%) of the workers. After administration of bronchodilator the % pred FVC became normal in all workers.

The % pred FEV1 was impaired in 75 (62.5%). the frequency of post bronchodilator was significantly decreased (35 (29.2%),  $p < 0.001$ ) meaning that 40 workers out of 75 (53.3%) improved on bronchodilator. The % pred FEV1 change after bronchodilator was  $>12\%$  in 45 out of the 75 workers with Pre-BD impaired FEV1 ( $\chi^2 = 25.7$ ,  $p < 0.001$ ) which means that 45 workers having positive FEV1 reversibility. The frequency of % pred FEV1/FVC  $< 85\%$  was 102 (85.0%) among all participants. The latter frequency increased to 115 (95.8%) after bronchodilator.

The % pred PEFr was impaired in 67 (55.8%). the frequency of impaired % pred PEFr was significantly lowered (13.3%),  $p = 0.000$  meaning that 51 workers out of 67 (76%) improved on bronchodilator. The % pred PEFr change after bronchodilator was  $\geq 20\%$  in 44 (36.7%) out of 67 workers with Pre-BD

impaired PEFR ( $x^2=25.7$ ,  $p<0.001$ ) which means that 44 workers having positive PEFR reversibility. Table(4) shows that Late PEFR among participants at wheat mills of south Cairo is lower than Early PEFR ( $5.8\pm 2.4$  [0-10.83] versus  $7.0\pm 1.2$  [4.4-9.7]) with a diurnal variability in the PEFR greater than 20% ( $21.0\pm 6.8$  [10.0-46.0]) which indicate occupational asthma.

Figure (1) shows that 25% of mills workers suffer from occupational asthma.

## Discussion

Occupational asthma is an international problem affecting 10% of the working adults.<sup>15</sup> Few studies were done on occupational asthma in Egypt focusing mainly on asthma symptoms. In this study a well designed questionnaire according to the last GINA guidelines 2014<sup>9</sup> as well as ventilatory functions tests focusing on bronchial reversibility and variability were done to workers of Helwan flour mills.

The current study reported that Many participant workers had recurrent RTI (28.3%) and asthma symptoms related to triggers (25.8%) mainly work which significantly resolved after awaking and improve at the end of work day as well as in the weekend .

This agrees with Tarlo et al. 2009<sup>7</sup> Who reported that these features are typical of occupational asthma .this is because the exposure to allergen is mainly at work so the symptoms appear during work, improve at the end of the day and resolve on awaking. the symptoms also improve in the weekend due to absence of allergen exposure. Nowadays These clinical characteristics became the diagnostics criteria stated by the GINA guidelines 2014<sup>9</sup>.

This study showed that significant numbers of asthmatics were normal on chest examination as well as chest x ray .This is in agreement with Nicholson et al.

2005<sup>5</sup> & Levy et al. 2009<sup>4</sup> who observed that the physical and radiological examination of the respiratory system of asthmatics were usually normal because asthma is associated by reversible variable airways obstruction.

This study showed also a significant improvement in the workers spirometric parameters: FVC, FEV1, FEV1/FVC, PEFR after bronchodilator administration .These findings are in accordance with Brouwer et al. 2008<sup>10</sup>; Levy et al. 2009<sup>4</sup> and Quanjer et al. 2012<sup>11</sup> who prove that asthma is characterized by variable airflow limitation in all spirometric parameters.

This study revealed reversibility in 45 workers by FEV1 reversibility test while 44 by PEFR reversibility test which is in agreement with Brouwer et al., 2008<sup>10</sup>; Reddel et al. 2009<sup>12</sup> and Tan et al., 2012<sup>13</sup> who reported that reversibility in ventilatory lung function is an Essential component of the diagnosis of asthma. Nowadays the GINA takes this diagnostic point in consideration in subjects with symptoms doubtful of asthma not in asymptomatic persons.

Reddel et al, 2009<sup>12</sup> and Quanjer et al., 2012<sup>11</sup> prove that Forced expiratory volume in 1 second Reversibility (FEV1) is more reliable than that of peak expiratory flow (PEF) which agree with our results. Nowadays GINA guidelines 2014<sup>9</sup> prefer FEV1 reversibility more than that of PEFR. In fact , we found thirty subjects out of 120 male workers suffering from occupational asthma representing around 25% of the workforce.

The current study doesn't agree with western studies approved by GINA like that of Culinan et al., 1994<sup>14</sup> who showed that the prevalence of occupational asthma among flour mills workers not exceed 14%. Another study done by Talini et al., 2002<sup>15</sup> found that the prevalence of occupational asthma among flour mills

workers became 10% due improvement of industrial hygiene.

The prevalence of occupational asthma among flour mills is low in western countries in comparison to our country. This may be attributed to the improvement in industrial hygiene as well as low level of growth of microorganisms causing asthma due to cold dry climate. The current study doesn't also agree with Eastern studies done in Asia and Africa. Like that of Ijadunola et al., 2004<sup>16</sup> who reported that the prevalence of occupational asthma among flour mills workers in Ibadan Governorate, Nigeria was 54%. Another study done by Narjis et al., 2007<sup>17</sup> found that the prevalence of occupational asthma among flour mills workers of Basrah Governorate, Iraq was 45%.

The prevalence of occupational asthma among flour mills is high in Eastern countries in comparison to our country. This may be attributed to high level of growth of microorganisms causing asthma due to hot humid climate.

This study isn't in accordance with a previous Egyptian study done by Gaafar et al. 1988<sup>18</sup> who found that the prevalence of occupational asthma among flour mills workers in Menoufia Governorate was 13%. This may be attributed to increase both temperature and humidity in Helwan in comparison to menoufia as well as global warming occurring in recent years allowing further growth of microorganisms as a result of climatic changes.

## Conclusion

From This study we concluded that the diagnosis of occupational asthma in workers previously undiagnosed can be performed by a well designed questionnaire focusing on asthma symptoms, its improvement, worsening, relation to triggers mainly work, Followed by pulmonary function tests to assess

bronchial reversibility and variability. We concluded also the importance of industrial hygiene measures in prevention as well early detection and treatment of susceptible workers.

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**Table 1: Characteristics of participant workers at wheat mills of South Cairo**

Variables N = 120	N (%)	Mean $\pm$ SD [min-max]
Age (years)		49 $\pm$ 5.6 [37-59]
BMI(kg/m <sup>2</sup> )		24.3 $\pm$ 0.7 [22.6-26.3]
Smoking		
Non-smoker	46(38.3%)	
Smoker	74(61.7%)	
Smoking Index (pack/year)		308.8 $\pm$ 305.7[0-1200]
Duration of exposure (years)		27.4 $\pm$ 5.1 [20-40]
Mill		
Sherouk	60 (50%)	
Tebbin	60 (50%)	

**Table 2. Clinical findings among participant workers at wheat mills of South Cairo**

	N (%)
Recurrent RTI (duration>10days)	34(28.3)
Asthma symptoms	31(25.8)
Asthma symptoms with triggers: cold air ,irritants, laugh	31(25.8)
Episodic chest tightness	31(25.8)
Asthma symptoms during work	30(25.0)
Asthma symptoms improve at the end of work day&weekend	30(25.0)
Episodic cough	28(23.3)
Episodic dyspnea	27(22.5)
Asthma symptoms resolve completely after awaking	24(20.0)
Chronic dyspnea	14(11.7)
Episodic wheezes	8(6.7)
Chronic productive cough	7(5.8)
Asthma symptoms resolve Partially after awaking	6(5.0)
Past history& family history of BA	2(1.7)
Asthma symptoms leading to night awaking	1(0.8)
Abnormal chest examination	7(8.1)
Abnormal chest X ray	7(8.1)

**Table 3.**The effect of the bronchodilator administration on percentage of workers with impaired spirometric parameters

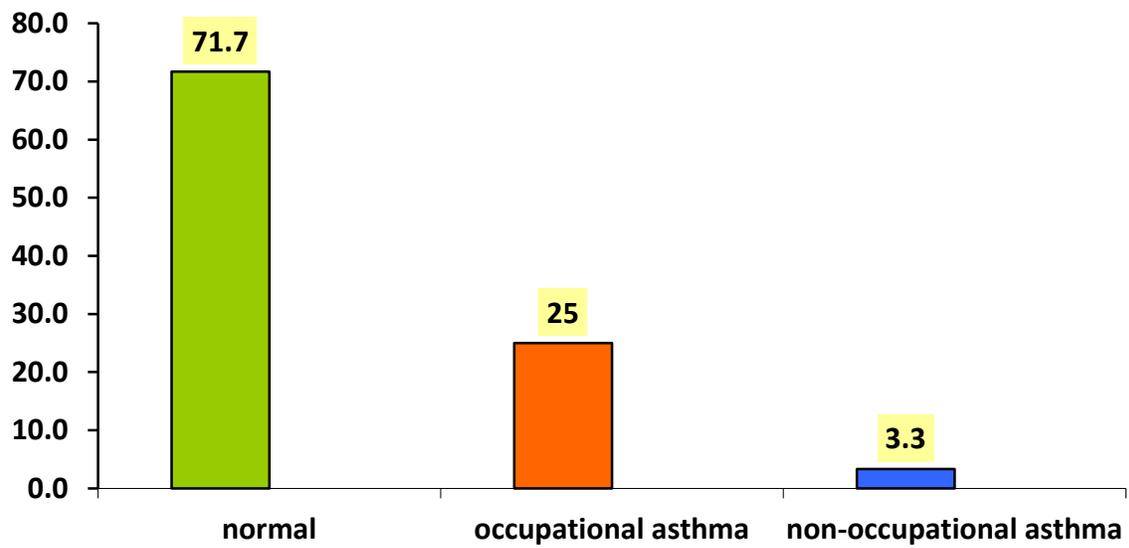
	BD intake	Impairment cutoff of % pred value	impaired total =120	Improved (increased)	Statistic #	P -value
			n (%)	n (%)		
% pred FVC	Pre-BD	< 80%	41 (34.2)		---	---
	Post-BD	< 80%	0 (0.0)	41		
% pred FEV1	Pre-BD	< 85%	75 (62.5)#		29.647	0.000*
	Post-BD	< 85%	35 (29.2)	40		
% FEV1 /FVC	Pre-BD	< 85%	102 (85.0)		17.289	0.001*
	Post-BD	< 85%	115 (95.8)	14		
% pred PEFr	Pre-BD	< 80%	67 (55.8)##		14.604	0.000*
	Post-BD	< 80%	16 (13.3)	51		

# McNemar test

**Table 4.**PEFR variability among participant workers at wheat mills of South Cairo

	Spirometric parameters in liter Mean $\pm$ SD [min-max]	Spirometric parameters % pred Mean $\pm$ SD [min-max]
<b>PEFR</b>		
Early-PEFR	7.0 $\pm$ 1.2[4.4-9.7]	78.1 $\pm$ 12.7[50.0-107.0]
late-PEF	5.8 $\pm$ 2.4 [0-10.83]	65.3 $\pm$ 16.5[30-118.0]
Variability		21.0 $\pm$ 6.8 [10.0-46.0]

#Variability: difference between percent predicted early and late PEFr



**Figure 1: Percentages of occupational and non-occupational asthma in South Cairo Mills(25% of mills workers suffer from occupational asthma)**