

# Occupational asthma in Sudan

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**Abstract-** Objectives: this study is designed to assess the effect of occupational exposure on respiratory symptoms and pulmonary functions of workers in Sudanese factories.

Methods: A cross sectional study was performed in four Sudanese factories, in Khartoum and Eight hundred and six workers from different factories were included, 319 workers from Khartoum refinery company, Khartoum state, 232 workers from Al Genaid sugar factory, 152 workers from Al Baraka biscuit manufacturing factory and 103 workers from Gezira tannery, Gezira state. Respiratory symptoms, pulmonary function and skin prick tests were evaluated.

Results: asthma symptoms have increased significantly after occupational exposure in all studied factories. Biscuit factory and Khartoum Refinery Company showed the highest asthma symptoms (35.5% and 31.3% respectively). FVC and FEV1 were found to be most affected by exposure. The sensitivity to different allergens in relation to subjects with abnormal pulmonary function was found to be very high in the refinery, 93%. Improper use of masks did not protect the workers.

Conclusion: Occupational asthma symptoms increase in workers in the tannery, biscuit, sugar factories and refinery company in Sudan with pulmonary functions deterioration.

**Index Terms-** occupational asthma, Sudan, lung function tests

## I. INTRODUCTION

In recent years, the prevalence of work-related asthma has increased; therefore, more attention needs to be paid to occupational allergens and their avoidance and control in workplaces.<sup>1</sup> The prevalence of asthma in Sudan is 12.5% in children according to ISAAC study phase three.<sup>2</sup> In Sudan few studies have investigated this effect in relation to benzene fumes, bakeries and cotton milling.<sup>3,4,5</sup> Asthma symptoms related to refining processes, sugar cane refining, tannery industry and flour exposure in biscuit factories needs further investigation.

The petroleum refining process was found to be significantly associated with respiratory symptoms<sup>6</sup>. Bashir and Musa in Khartoum state, Sudan found a significant reduction in FVC and FEV1 as a result of chronic exposure to benzene<sup>2</sup>. The decrease in FVC values was directly proportional to the duration of exposure. On the other hand different studies have confirmed the hazardous effects of sugar cane refining on the respiratory system<sup>7,8,9</sup>. In Sudan, no previous studies have investigated these parameters.

Many studies have shown that flour dust exposure causes respiratory symptoms and is associated with impairment of lung function<sup>10,11,12</sup>. In Sudan Ahmed et al found that working at the bakeries for three years or more significantly lower FEV1 and FVC and increases respiratory symptoms<sup>4</sup>.

Long-term exposure to solvents and chromium compounds in tannery factories had adverse effects on respiratory systems in tannery workers<sup>14,15</sup>. Health status was studied in tannery factories in India<sup>16</sup> and showed that nearly 46% of all workers had impairment suggestive of mild to moderate obstruction. About 5% of the workers had severe restriction. Varying prevalence of asthma (2.2% and 38%) among leather tannery workers in India has been reported previously<sup>17,18,19</sup>.

This study aimed at whether occupational exposures during petroleum refining, leather processing, sugar refining and biscuit manufacturing processes in Sudan affect the pulmonary function through studying asthma symptoms prevalence, pulmonary function testing and skin prick testing for hypersensitivity to common allergens.

## II. METHODS

A cross sectional study was conducted between June 2007 and January 2010. Ethical clearance was approved by the ethical committee of the faculty of medicine, university of Gezira. Eight hundred and six workers from different factories were included, 319 workers from Khartoum refinery company, Khartoum state, 232 workers from Al Genaid sugar factory, Gezira state, 152 workers from Al Baraka biscuit manufacturing factory, Gezira state and 103 workers from Gezira tannery, Gezira state. Both sexes and all age groups were included. Any worker with heart diseases, chest pain or with recent abdominal or thoracic surgery was excluded. Questionnaires were filled out by all participants. Weight in kilograms and height in centimeters were measured using a stadiometer. Pulmonary function tests using a spirometer (for measurement of FVC, FEV1 and percent of FEV1 to FVC) and peak flow meter (for measurement of PEF) were performed for all participants. Three trials were done and the best reading was taken as indicative of individual highest ability. The best measurement from each subject test was compared with standard predicted value from pulmonary function reference values of normal Sudanese<sup>20</sup>. Reversibility test to inhaled salbutamol and sensitivity to different common allergens were performed to participants with abnormal pulmonary function tests measurements compared to predicted.

## III. RESULTS

The study revealed that asthma symptoms have increased significantly after occupational exposure in all studied factories ( $p < 0.05$ ). Biscuit factory and Khartoum Refinery Company showed the highest asthma symptoms after occupational exposure 35.5% and 31.3% respectively then the tannery 20.4% and sugar factory 17.9% (fig 1).

The results of our study showed that there was pulmonary function deterioration in all factories as both FEV1 and FVC were found to be decreased in all factories except for the tannery where only FVC was found to be decreased. The deterioration was found to be significant in the refinery and the biscuit factory (table 1).

The sensitivity to different allergens in relation to subjects with abnormal pulmonary function was found to be very high in the refinery 93%, followed by biscuit 43.8%, tannery 28.6% and sugar 26.1%. Whereas reversibility test in relation to subjects

with abnormal pulmonary function was found to be positive as follows: 57.1%, 50%, 43.5% and 25% for the tannery, biscuit, sugar and refinery company respectively (table 2).

Refinery workers were well educated as most of them have university degrees, whereas most of sugarcane workers, al Baraka biscuit workers and the tannery workers were of higher school, secondary and primary school level. Wearing masks did not protect from asthma symptoms in three factories. In refinery wearing masks decreases asthma symptoms (fig 2).

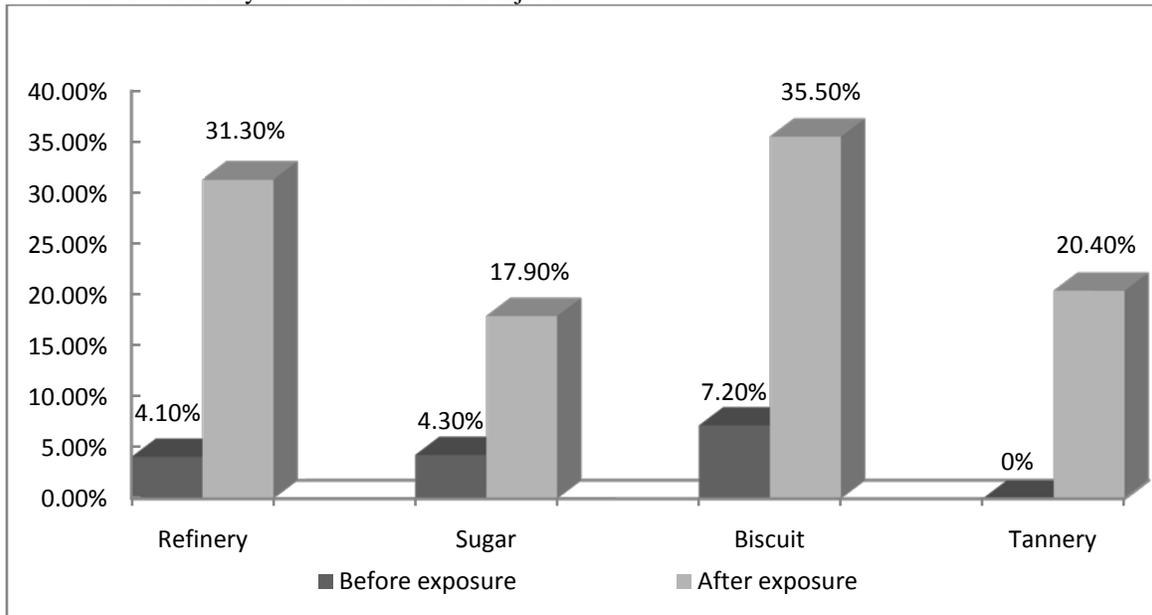


Figure 1: Asthma symptoms before and after occupational exposure in Sudanese factories workers

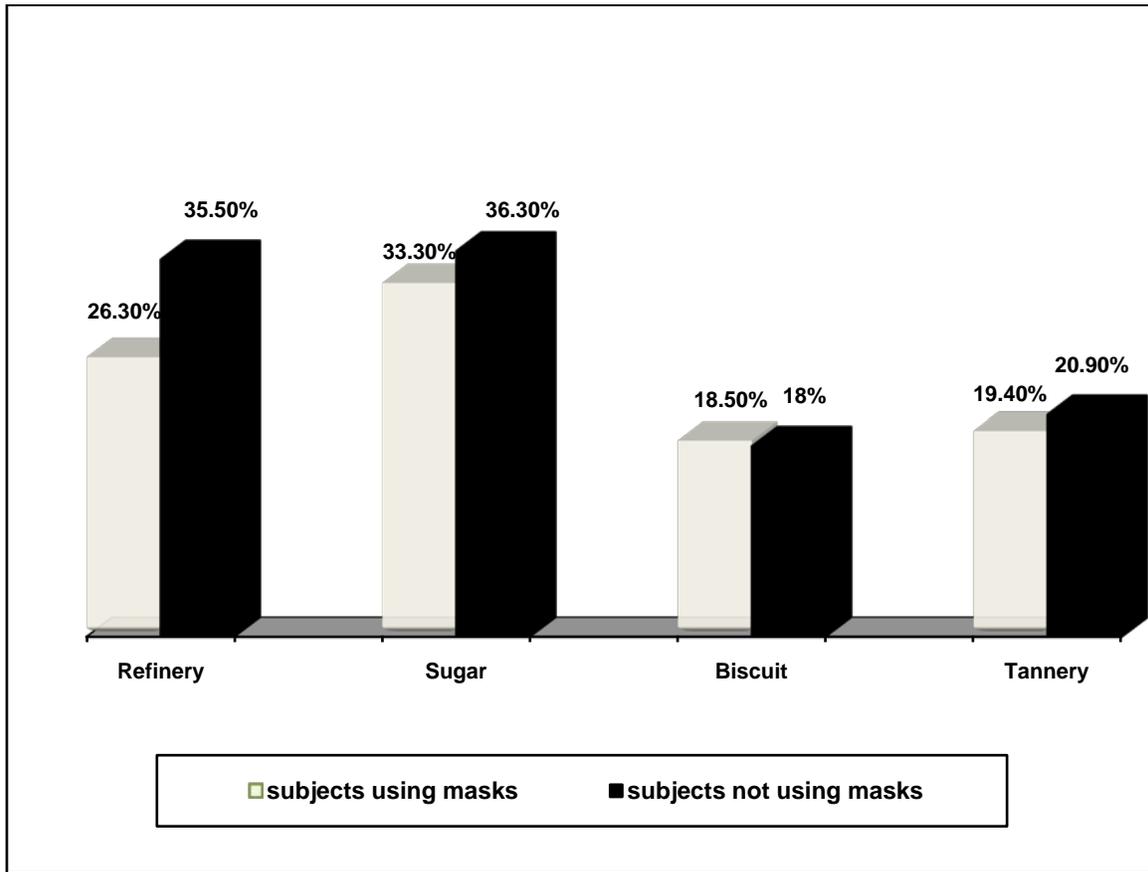
Table 1: Percent of pulmonary function deterioration compared to predicted values:

	Refinery	Sugar	Biscuit	Tannery
<b>FEV1 Liter</b>	- 12.5%	- 0.3%	- 8.7%	0.9%
<b>FVC Liter</b>	- 19.1%	- 6.3%	- 30.8%	- 1.8%
<b>PEFR L/min</b>	- 0.3%	10.8%	1.2%	1%

Table 2: Skin prick test and reversibility in relation to subjects with abnormal pulmonary function:

	Refinery	Sugar	Biscuit	Tannery
<b>Asthma symptoms</b>	31.40%	17.90%	35.50%	20.40%
<b>Abnormal pulmonary function test</b>	13.80%	10%	10.50%	13.60%
<b>Positive Skin prick test</b>	93%	26.10%	43.80%	28.60%

<b>Positive Reversibility test</b>	25%	43.50%	50%	57.10%
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**Figure 2: Effect of using masks on asthma symptoms among the Sudanese factories workers:**

#### IV. DISCUSSION

It is logic to find ventilatory deterioration in all factories as for sure the environment in the factories is more contaminated than the general environment due to the presence of different pollutants. It is also not surprising to find that refinery workers have the highest ventilatory deterioration as it is highly polluted. Biscuit workers were also found with high ventilatory deterioration and this may be due to the strong allergenic properties of flour. Tannery was found with the lowest ventilatory deterioration, and this is due to good ventilation in the factory.

As many substances in the workplace can cause occupational asthma, it's not surprising to find that asthma symptoms increased in all factories compared to the general population. The lowest asthma symptoms in our results (17.9% in sugar factory) were found to be more than what found by Musa et al (2008) in the general population (9%)<sup>21</sup>. It is logic to find that the biscuit factory has the highest asthma symptoms due to the strong allergenic properties of flour<sup>22</sup> that make bakers at higher risk of occupational asthma. Many studies have shown that flour dust exposure causes respiratory symptoms and is associated with impairment of lung function<sup>11,12,13,14</sup>. Refinery was also found with high asthma symptoms and this is because of the higher and

different contaminants that refineries release and for this reason many governments put restrictions on the place of the refinery building which is usually far away from people inhabitants.

The sensitivity of the workers of the refinery to the different common allergens was found to be very high (93%). Flour is known allergen so the skin prick test was found to be also high in the biscuit factory (43.8%). If the allergen used was the specific allergen for each factory the sensitivity would have been higher than what we have found, and the cost and availability of specific allergens hindered their use .

Using masks was found to be effective in protecting from asthma symptoms in refinery but not effective in sugar, biscuit and tannery and this may be due to the high level of education in refinery workers that makes the workers use the masks more properly than non educated subjects.

It is concluded that occupational exposure increases asthma symptoms and deteriorates pulmonary function among Sudanese factories workers. So we recommend that pulmonary function tests should be a prerequisite for employing workers in factories and then regularly performed to detect early deterioration in respiratory function. Occupational health departments should follow the national criteria of safety and ascertain its application through regular monitoring. Masks should be available in these factories and a strict rule for wearing them is recommended.

Strong attention should be paid to working conditions in the Sudanese factories. Annual environmental survey by occupational health specialists should be performed to detect all types of pollution and hazards in work environment so as to control them.

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