Effects of exposure to flour dust on respiratory symptoms and lung function of bakery workers: a case control study

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ABSTRACT

Background: Many studies have shown that exposure to flour dust is associated with development of respiratory symptoms and varying degree of reduction in lung function. These depend on work environment and duration of exposure. There is no published data from Sudan where work conditions may be different.

Objectives: This study was designed to assess the effect of exposure to flour dust on respiratory symptoms and lung function of bakery workers at a number of bakeries in Khartoum state.

Methods: A total of 36 bakery workers who work for eight hours or more and 40 control subjects matched for age, sex, height, and area of residence were studied. Respiratory symptoms were evaluated using a structured questionnaire and lung function was measured using a portable spirometer. Results were compared using the paired *t*-test.

Results: Daily work related respiratory symptoms were significantly increased in cases compared with controls. For those who worked at the bakeries for less than three years there were no significant differences in FEV1 or FVC, percent predicted when compared with controls. However, bakery workers who worked at the bakeries for three years or more have significantly lower FEV1 and FVC, percent predicted when compared with controls.

Conclusions: Exposure to flour dust causes increased work related respiratory symptoms in bakery workers who work for eight hours or more. In these workers prolonged exposure to flour dust causes significant reduction in lung function as measured by FEV1 or FVC, percent predicted

Introduction

There is growing consensus on the deleterious effects of organic dust on respiratory symptoms and function of industrial workers; flour dust is widely incriminated to cause such effects. Exposure to flour dust occurs across a range of food industries including grain mills, flour mills and bakeries. Wheat flour is a complex organic dust with a large diversity of antigenic or allergenic components. The antigens involved can be wheat flour proteins, flour parasites or technical additives such as enzymes. [1] Wheat flour consists of water-soluble albumins, salt-soluble globulins, gliadins and glutens. Albumins and globulins appear to be the most important proteins contributing to immediate hypersensitivity reactions to wheat proteins. [2]

Many studies have shown that flour dust exposure causes respiratory symptoms and is associated with impairment of lung function.3-5 Flour dust is an asthmagen and is known to cause sensitization, allergic rhinitis and occupational asthma amongst bakers and millers. [6] Flour dust can also act

as an irritant and may give rise to short-term respiratory, nasal and eye symptoms, or it may provoke an asthma attack in individuals with pre-existing disease. [7] In the UK, for example, flour and grain dust are the second most commonly cited agents associated with occupational asthma.[7]

The respiratory effects of exposure to flour dust are influenced by the dose and duration of exposure, [8-10] and these differ from one work environment to another. Therefore, it may not be correct to extrapolate the results of studies conducted in a different environment to our bakeries.[3-5] This study was conducted to investigate the effects of exposure to flour dust on respiratory symptoms and lung function in the environment of bakeries in Khartoum state, Sudan.

Materials and methods

The study included bakery workers working at eight bakeries in Khartoum state (the cases), and healthy non smoking control subjects matched for age, sex, height, and area of residence (the controls). The inclusion criteria for the cases were age from 18 to 65 years and working at the bakeries for eight hours or more per day. Bakery workers with skeletal abnormalities, neuromuscular diseases, history of smoking, known cases of bronchiectasis or asthma were excluded from the study. Exclusion criteria for the controls were similar to those of cases. In addition, all controls who previously worked at bakeries were excluded from the study. Initially, 64 bakery workers were randomly selected from the eight bakeries in Khartoum state. Of these 64 only 36 fulfilled the inclusion and exclusion criteria and were included in the study. For the controls initially 60 matched controls were selected. Of these 20 were excluded based on the above exclusion criteria and 40 were included in the study. An informed consent was obtained from all cases and controls. A structured questionnaire was used to collect anthropometric and clinical data, and duration of work at the bakeries for the cases. Respiratory symptoms such as cough, sputum production, shortness of breath, wheeze and chest discomfort were referred to as work related symptoms. Pulmonary function tests were carried out using a portable electronic spirometer. All pulmonary function tests were done at a fixed time of the day: between 9.00 and 15.00 hours. The maneuver was explained to each subject. All subjects performed the maneuver in the standing position and the best of three readings was recorded. The results were compared using the paired *t*-test.

Results

All cases and controls were male. **Table 1** shows the anthropometric data for the cases and controls. Cases and controls were matched for age, height and weight. **The figure** shows work related respiratory symptoms in cases and controls. One quarter of bakery workers had work related symptoms significantly higher than those in controls where only one in twenty were symptomatic. **Table 2** shows spirometric results of the bakery workers and matched controls. For those who worked at the bakeries for less than three years there was no significant difference between cases and controls in mean FEV1 or FVC, percent predicted. However, bakery workers for three years or more scored significantly lower mean FEV1 and FVC, percent predicted when compared with controls.

Table 1: Anthropometric data of bakery workers at eight bakeries in Khartoum state and control subjects.

Parameter	Flour bakers (cases) N=36	Control subjects (controls) N=40
Age (years) mean ± SD	29.3 ± 7.5	31.9 ± 6.5
Height (centimetres) ± SD	170.8 ± 8.1	172.3 ± 5.4
Weight (kilograms) ± SD	60.5 ± 12.7	65.4 ± 11.8

The Figure: Lung function results in bakery workers at eight bakeries in Khartoum state and control subjects

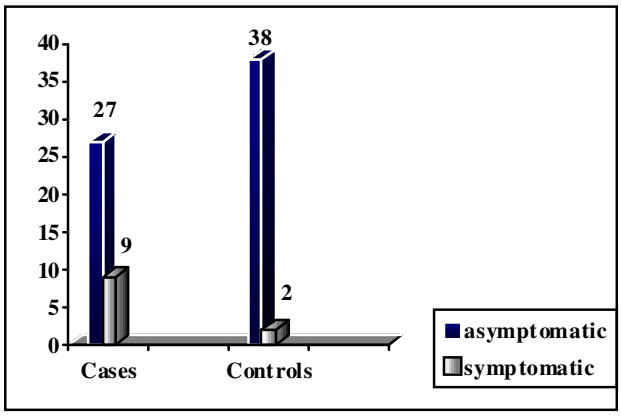

Table 2: Lung function results in bakery workers at eight bakeries in Khartoum state and control subjects.

Duration of work less than three years			Duration of work three years or more		
Variable	Mean FEV1 % predicted	Mean FVC % predicted	Variable	Mean FEV1 % predicted	Mean FVC % predicted
Cases (17)	102	92	Cases (19)	84.8	84
Controls (5)	90	85	Controls (35)	95.9	92
p value	0.17	0.28	p value	0.02	0.05

Discussion

The present study has shown that exposure to flour dust in bakeries in Khartoum State is associated with increased respiratory symptoms and impairment of lung function if exposure continues for three years or more. This is in agreement with previous studies conducted in settings different to ours.3-6,11,12 Previous reports with similar findings were conducted at both flour industry settings like flour and grain mills,11,12 and bakeries.3-6,8 The harmful respiratory effects of flour dust are well documented and are believed to result from wheat flour proteins including albumins and globulins, flour parasites and added enzymes.1,2 Therefore, it is not surprising that these harmful effects are seen across a wide range of flour industrial settings and bakeries.

The strength of our study, however, comes from two points: the case-control design and the exclusion of individuals with pre-existing known respiratory diseases and history of smoking which could have acted as compounding factors affecting respiratory symptoms and lung function. Similar studies have shown that the respiratory symptoms in those exposed to flour dust to range from 10% to 70%, but most of these studies were not case controlled,[3-6,10,13] and none excluded individuals with pre-existing lung disease. Therefore, we believe that the prevalence of respiratory symptoms of 25% among the bakery workers in our study is more accurate. The prevalence of respiratory symptoms of 5% among control subjects is in agreement with figures of respiratory symptoms in individuals without known respiratory disease (about 7%).[14] This lends further support to the robustness of the design of the present study and indicates that the difference in symptoms between cases and controls is real. We can not be sure whether bakery workers who are exposed to flour dust for less than eight hours per day will have less respiratory symptoms. Nevertheless, the workers we studied are representative of the current work practices at bakeries in Khartoum State where most adopt shifts of eight hours or more.

Previous studies on individuals working in flour industry and bakeries have shown that there is a dose exposure relationship.3,6,7,10,12,15 Therefore we opted to study a group with prolonged exposure to flour dust: those who worked for three years and more. We observed that prolonged exposure to flour dust causes reduction in both FEV1 and FVC. This is in agreement with other studies.6,7,12,15 In assessing lung function we used spirometry measuring FEV1 and FVC as opposed to peak expiratory flow measurement which would have just measured air flow obstruction. Other studies have shown that the impairment of respiratory function affects both FEV1 and FVC.[6,7,12,15] The level of lung function impairment we observed in those who worked for three years and more is significant specially that the mean age of bakery workers is 29.3 years. A disability at this early age will have considerable socioeconomic impact on these workers and their dependants.

The results of the present study support paying stringent attention to working conditions in bakeries in Khartoum state. We recommend that detailed regulations should be issued by the Ministry of Health in this respect and they should be legally binding. Also, there should be regular monitoring to ensure the implementation of these regulations. Such regulations are in place in other countries. For example, under the United Kingdom Control of Substances Hazardous to Health (COSHH) Regulations 2002, flour dust is defined as a hazardous substance and a maximum exposure limit (MEL) for flour dust was set at 10 mg/m3 [8 h time-weighted average (TWA)] with a short-term exposure limit (STEL) of 30 mg/m3 (15 min reference period).[16] Adequate control of exposure to flour and ingredients dust should help to reduce the incidence of respiratory disease in the baking industry, which should be one of the priority objectives of occupational health.

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