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ORIGINAL ARTICLE

Effects of exposure to flour dust on respiratory symptoms and pulmonary function of mill workers

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KEYWORDS

Flour mill workers;
Flour dust;
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Abstract *Objective:* To assess the effect of exposure to flour dust on respiratory symptoms and lung function of flour mill workers and to estimate the additive effect of smoking on pulmonary function.

Patients and methods: This study was carried out at flour mills in Sohag Governorate. Two hundred male workers with current exposure to flour dust and two hundred non-exposed male as a control group were interviewed and self designed study questionnaire was administered to them and the parameters of their pulmonary function were measured.

Results: Respiratory symptoms such as cough, expectoration, wheezing, and shortness of breath, were significantly ($p < 0.0001$) higher among exposed workers as compared to unexposed. Furthermore highly significant ($p < 0.0001$) decrements in the pulmonary function of exposed subjects were noted. Moreover, a highly significant decline in FEV1%, FVC% and FEV1/FVC% was noticed regarding the duration of exposure to flour dust ($p < 0.0001$). Also, there was a highly significant difference between heavily exposed compared to lightly exposed subjects ($p < 0.001$).

The additive effect of smoking was noticed as there was a highly significant decline of FVC%, FEV1%, FEV1/FVC%, FEF25% and FEF75% in smokers compared to non-smokers ($p < 0.0001$).

Conclusion: Flour mill workers in Sohag Governorate, like grain workers elsewhere, were at an increased risk of developing pulmonary symptoms, a strong association exists between exposure to

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flour dust and the prevalence of respiratory symptoms and functional impairments of the lungs. The result has implications for improved dust control measures in the grain industry in Egypt.

Introduction

The respiratory health effects have been documented in workers exposed to a variety of dusts in small and large-scale industries, which generate dust during their production process. The diseases of the respiratory system induced by occupational dusts are influenced by the type of dust, dose, duration of exposure and genetic factors [1,2]. Occupational diseases are caused by a pathologic response of the patients to their working environment [3]. A threshold limit value of 0.5 mg/m^3 of flour dust was proposed in 2009 by the American Conference of Governmental Industrial Hygienists (ACGIH) as the occupational exposure level (OEL) in breathing zones for workers in flour mills [4].

The American Conference of Governmental Industrial Hygienists (ACGIH) defines flour as a complex organic dust consisting of wheat, rye, millet, barley, oats or corn cereal, or a combination of these, which have been processed or ground by milling [5] and may contain a large number of contaminants including silica, fungi and their metabolites (aflatoxin), bacterial endotoxins, insects, mites, mammalian debris and various chemical additives such as pesticides and herbicides [6]. The gram negative bacterial endotoxins can elicit profound immunotoxic and immunomodulating effects in vitro and in vivo [7] and therefore can exacerbate adverse pulmonary reactions to grain dust. Exposure to flour dust occurs across a range of food industries including grain mills, flour mills and bakeries. The level of dust exposure is highest in the mixing and packing sites of the flour mills [8].

Wheat flour is a complex organic dust with a large diversity of antigenic or allergic components [9]. The antigens involved can be wheat flour proteins, flour parasites, silica, fungi, insects or technical additives such as enzymes [10]. Multiple allergens exist in the protein fraction of wheat flour that are responsible for respiratory dysfunctions and baker's asthma [11,12].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 [13]. Proteomic studies have shown that gliadin and glutenin account for a high proportion (80%) of the wheat proteins [14,15]. Gliadin and glutenin have also been found effectively implicated in wheat flour-related allergic diseases [16,17]. Accordingly, immunological responses to flour exposure have been reported in bakers and mill workers based on the elevation of serum IgE, IgG and IgA antibodies [18–20].

Flour dust is a hazardous substance; it is a respiratory sensitizer and is known to cause allergic rhinitis and occupational asthma among bakers and millers [21]. Asthma arising from workplace exposure to cereal flour (bakers' asthma) is one of the commonest types of occupational asthma [22,23]. It is also an irritant and may give rise to short term respiratory, nasal and eye symptoms or it may provoke an asthmatic attack in individuals with pre-existing disease and also lead to chronic bronchitis [24]. In addition, flour and / or grain mill workers have been reported to exhibit a variety of clinical manifestations including wheezing, febrile reactions, grain fever, lung fibrosis, allergic alveolitis, impairment of lung function and chronic obstructive pulmonary disease [25,26]. In occupational respiratory disease, spirometry is one of the most important diagnostic tools. Measurement of dynamic lung functions is more important than of static lung volumes. Lung function tests are beneficial in the early recognition of pulmonary dysfunctions even if the workers may be normal clinically [27].

This study was conducted to investigate the effects of exposure to flour dust on respiratory symptoms and lung function of flour mill workers in Sohag, Egypt and to assess the additive effect of smoking on pulmonary function parameters.

Materials and methods

Study population

This study was conducted in the flour mills located in Sohag Governorate, Southern Egypt between March 2009 and November 2011. Two hundred flour mill workers with a mean age of 38.8 ± 11.2 years (range17–66 years), were enrolled in this study. These flour mill workers worked for at least 8–10 h a day for 6 days per week, without using any self-protective measures. In addition, an equal group of unexposed office workers with a mean age of 40.5 ± 9.6 years (range 22–59 years), matched the flour mill workers by sex, age, residence, body mass and social class was studied as a control.

Questionnaire

All subjects were interviewed by a physician who filled the questionnaire. The questionnaire included, among other items, questions on work history, respiratory symptoms, and smoking status of the study subjects. The work histories of the study subjects were assessed through questions on previous and current job, daily working time, job description, working conditions, ventilation conditions, and protective measures used. Respiratory symptoms (cough, phlegm, dyspnea, wheezing, and chest tightness) were documented. 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. General and local examination of all body systems on emphasize of the respiratory system were carried out for all participants.

Education level: was divided into two groups.

(1) ⩽9 education years (compulsory education).
(2) More than 9 education years.

Smoking index: It was divided into three grades by smoking degree (number of cigarettes smoked daily multiplied by the number of smoking years), according to classification of Nitti [28], we classified smokers into: