

BRIEF COMMUNICATION

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Pulmonary Function Tests and Work-Related Respiratory and Allergic Symptoms in Iranian Bakers

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ABSTRACT

Bakers are frequently exposed to various irritant chemicals during work which can induce respiratory problems. In this study, pulmonary function tests and self-reported respiratory and allergic symptoms in bakers were compared with matched control subjects.

The frequency of respiratory and allergic symptoms was evaluated in a sample of 58 Iranian bakers and 58 control subjects using a questionnaire. Pulmonary function tests (PFT) were also measured in all participants.

All respiratory symptoms were significantly higher in bakers than control group ($p < 0.05$ to $p < 0.005$). All allergic symptoms in bakers were also significantly greater than control group ($p < 0.05$ to $p < 0.005$). In addition, all respiratory (except sputum) and allergic (except urticaria) symptoms were significantly higher in bakers compared to rest period ($p < 0.05$ to $p < 0.01$) during work. Most PFT values except MEF_{25} were also significantly lower in bakers than control subjects ($p < 0.05$ to $p < 0.001$).

These results showed that bakers have a higher frequency of work related respiratory symptoms and to a lesser extend allergic symptoms particularly during the work period. PFT values were also significantly reduced among bakers.

Key words: Allergic symptoms; Bakers; Pulmonary function test; Respiratory symptoms

INTRODUCTION

Occupational diseases are a major concern and many studies have been conducted to determine high risk occupations inducing respiratory diseases. Observatoire National des Asthmes Professionnels (ONAP) reported the highest risk of occupational asthma in bakers and pastry makers (683/million).¹

Increased prevalence of allergic disorders and asthma has been described in several studies²⁻⁴ including bakers of Tehran city.⁵ The effect of exposing to flour in induction or increasing the allergic disorders including dermatitis, allergic rhinitis and other allergic diseases were also shown.⁶⁻⁸ The existence of increased airway and cutaneous responsiveness in bakers⁹⁻¹¹ and increased respiratory and allergic symptoms¹² as well as nose inflammation¹³ were shown. In this study, lung function and self reported prevalence of work related respiratory and allergic symptoms among bakers were compared to unexposed controls in Mashhad city (north-east of Iran).

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PATIENTS AND METHODS

Population

A cross sectional study was designed in the city of Mashad, to assess respiratory and allergic symptoms and lung function tests in a cohort of bakers who have being exposed to chemicals, and a control group of unexposed subjects. The study included 58 bakers (56 male, 2 female, age: mean $\pm$ SD = 32.10 $\pm$ 11.60 year) and 58 matched controls (56 male, 2 female, age: mean $\pm$ SD = 31.83 $\pm$ 12.45 year). Two bakers and non of the control subjects was smoker. Mean daily work in bakers was 10.48 $\pm$ 2.02 (mean $\pm$ SD) hours and mean work history was 12.94 $\pm$ 10.96 years. The bakers worked in different bakeries and the controls were selected from the same residential district, all subjects resided in Mashad city. Participants were selected by non-probable purposive method. All participants answered the designed questionnaire by a face-to-face interview. The study was approved by the ethical committee of Mashhad University of Medical Sciences, Mashhad, Iran.

Protocol

A questionnaire derived from preexisting studies¹⁴⁻¹⁷ was used to assess the respiratory and allergic symptoms. The questionnaire included questions on exposure pattern, respiratory symptoms, rhinoconjunctivitis, dermal reactions, history of allergic reactions, smoking habits, working hours per day and total working period. Pulmonary function tests in bakers and control subjects were measured using a spirometer with a pneumotachograph sensor (Model ST90, Fukuda, Sangyo Co., Ltd. Japan). Prior to pulmonary function testing, the required manoeuvre was demonstrated by the operator, and subjects were encouraged and supervised throughout test performance. Pulmonary function testing was performed using the acceptability standards outlined by the American Thoracic Society (ATS) with subjects in a standing position and wearing nose clips.¹⁸ All tests were carried out during 1000 and 1700 hours. Pulmonary function tests were performed three times in each subject with an acceptable technique. The highest level for forced vital capacity (FVC), forced expiratory volume in one second (FEV₁), peak expiratory flow (PEF), maximal mid expiratory flow (MMEF) and maximal expiratory flow at 75%, 50%, and 25% of the FVC (MEF₇₅, MEF₅₀, and MEF₂₅ respectively) were taken independently from the three curves.

Data Analysis

The data of PFT values and age were expressed as mean $\pm$ SD and data of respiratory and allergic symptoms

as percentage of each group having the corresponding symptom. Differences in the data of symptoms between bakers and control group and in bakers between work and rest period were tested by Chi-Squared analysis on 2X2 contingency tables and also tested by calculating Relative Risk and the 95% Confidence Intervals (RR, 95% CI.). The data of PFT values between bakers and control group were tested using unpaired t test. A two-sided p value of 0.05 was the criterion for statistical significance.

RESULTS

Comparison of Respiratory and Allergic Symptoms between Bakers and Control group

A total of 26(45%) of participants reported work-related respiratory symptoms. Sputum (17.2%) and cough (15.5%) were the most common symptoms and only 8.6% and 13.8% of bakers reported wheezing and breathlessness respectively. All respiratory symptoms were significantly higher in bakers than control group ($p < 0.005$ for sputum and $p < 0.05$ for other symptoms, Table 2). In addition, all allergic symptoms in bakers were also significantly greater than control group ($p < 0.05$, Table 1).

The Effect of the Exposure with Flour on Respiratory Symptoms

Most respiratory (except sputum) and allergic (except urticaria) symptoms were significantly higher in bakers during work compared to rest period ($p < 0.05$ to $p < 0.01$, Table 1).

Comparison of PFT Values between Bakers and Control Group

Most PFT values except MEF₂₅ were significantly lower in bakers than control subjects ($p < 0.05$ to $p < 0.001$, Table 2).

DISCUSSION

The results of the present study showed a greater respiratory and allergic symptoms and lower PFT values in bakers compared to control subjects which indicate the effect of the exposures to wheat flour on respiratory status of bakers and showed that irritant chemicals related to wheat flour and fungal enzyme can induce allergy in people working as baker. In addition, the respiratory and allergic symptoms were significantly higher while bakers were at work comparing to when they were not. This finding confirms that exposure to chemicals in work environment induces respiratory and allergic symptoms.

Pulmonary Function Tests and Respiratory Symptoms in Bakers

Table 1. Comparison of respiratory (R.S.) and allergic symptoms (A.S.) between control subjects and bakers and between rest and work period in bakers

Symptoms		Control group		Baker		RR	95% CI	Statis. Dif.
		No	%	No	%			
R.S.	Cough	4	6.9	9	15.5	0.609	0.325-1.141	p<0.05
	Sputum	2	3.5	10	17.2	0.355	0.146-0.867	p<0.005
	Breathless	3	5.2	8	13.8	0.501	0.146-0.867	p<0.05
	Wheezing	1	1.7	5	8.6	0.351	0.099-1.238	p<0.05
A. S.	Sneezing	3	5.2	8	13.8	0.501	0.146-0.867	p<0.05
	Runny nose	4	6.9	9	15.5	0.609	0.325-1.141	p<0.05
	Itchy eye	3	5.2	7	12.0	0.567	0.268-1.199	p<0.05
	Urticaria	1	1.7	8	13.8	0.235	0.064-0.864	p<0.005
Symptoms		Rest period		Work period		RR	95% CI	Statis. Dif.
		No	%	No	%			
R.S.	Cough	2	3.5	7	12.0	0.480	0.203-1.132	p<0.05
	Sputum	6	10.3	10	17.2	0.712	0.427-1.188	NS
	Breathless	1	1.7	7	12.0	0.271	0.075-0.986	p<0.01
	Wheezing	0	0	5	8.6	0.00	Infin.-Infin.	p<0.005
A. S.	Sneezing	1	1.7	7	12.0	0.271	0.075-0.986	p<0.01
	Runny nose	2	3.5	7	12.0	0.480	0.203-1.132	p<0.05
	Itchy eye	1	1.7	6	10.3	0.320	0.090-1.142	p<0.05
	Urticaria	3	5.2	5	8.5	0.699	0.341-1.432	NS

Values are presented as the number and percentage of subjects of each group having the corresponding symptoms (for each group n=58), Statis. dif: statistical differences, NS: non significant differences, RR: Relative risk, 95% CI: 95% Confidence Interval.

Table 2. Comparison of pulmonary functional tests (PFT) between control subjects and bakers

PFT Values	Control subjects	95% CI	Bakers	95% CI	Statistical dif.
FVC	98.05 ± 22.76	90.57 - 105.53	86.92 ± 21.85	81.17- 92.66	p< 0.01
FEV ₁	96.00 ± 28.45	86.65 - 105.35	87.88 ± 14.15	84.16 - 91.60	p< 0.05
MMEF	98.19 ± 23.76	90.27 - 106.11	88.30 ± 28.11	80.62 - 95.97	p< 0.05
PEF	98.16 ± 26.91	89.42 - 107.11	70.40 ± 22.37	64.53 - 76.28	p< 0.001
MEF ₇₅	101.22 ± 23.49	93.38 - 109.05	75.54 ± 26.69	68.25 - 82.82	p< 0.001
MEF ₅₀	100.05 ± 26.04	91.49 - 108.61	90.44 ± 30.44	82.43 - 98.43	p< 0.05
MEF ₂₅	105.24 ± 40.83	91.63 - 118.85	111.23 ± 36.26	101.6 - 120.85	NS

Values were presents as mean ± SD (for each group n=58). FVC: forced vital capacity, FEV₁: forced expiratory volume in one second, MMEF: maximal mid expiratory flow, PEF: peak expiratory flow, MEF₇₅, MEF₅₀, and MEF₂₅: maximal expiratory flow at 75%, 50%, and 25% of the FVC, respectively, dif: difference. 95% CI: 95% Confidence Interval.

Although epidemiologically crude by today's standards, they showed that bakers have more respiratory symptoms, sometimes labeled as asthma and considered as "normal", but also nasal symptoms, indicating baker's rhinitis.¹⁹ Previous studies emphasized the important role of personal atopy as a predisposing factor in the development of occupational disease among bakers.²⁰ Exposure to wheat flour and other sensitizing agents at bakeries could induce allergy at first, and this in turn can accelerate the induction of respiratory disorders. Atopy based on the skin prick test is useful for identifying subjects with allergic disease, but should not be used to exclude non-symptomatic atopic people from bakery work.²¹ Sensitization to bakery allergens seems to be the main cause of baker's asthma and rhinitis but cannot explain the asthma case history in each case.²² Further methods are required to objectively access irritative pathomechanisms. Our findings indicate the necessity

for an improved primary prevention of exposure to inhalative noxae in bakeries.

Bakers also are exposed to fungal allergens which could be the cause or at least, in part, leading to induction of allergy and respiratory symptoms. The fungal amylase is the principal sensitizer in large scale bread bakeries, with the main source of exposure being the handling of bread improvers. In contrast, the risk of sensitization to wheat flour is low in both bread and cake bakeries. The absence of positive skin-prick tests in the subgroup of cake bakery employees who regularly handle fungal-amylase-containing flour suggests that their levels of exposure are below the threshold for sensitization to amylase.⁹

The results of the present study showed significantly greater respiratory and allergic symptoms during work compared to rest period. These observations confirm that exposure to wheat flour and other allergens in bakers are mainly responsible for development of allergic and respi-

ratory symptoms. However reduction of PFT values and existence of respiratory symptoms in rest period in bakers indicate a permanent respiratory change in bakers.

The existence of increased airway and coetaneous responsiveness in bakers were also shown in different studies.⁹⁻¹¹ Occupational exposure to flour and smoking increase bronchial responsiveness, as measured by the slope of the dose-response to methacholine and the variation coefficients of airflow. However, methacholine bronchial responsiveness and the variability of lung function do not measure exactly the same aspect of airway behavior.¹⁰ Increased respiratory and allergic symptoms and reduction in PFT values may also suggest increased airway responsiveness in Iranian bakers. However, the existence of airway responsiveness in Iranian bakers should be examined in further studies.

In conclusion, the results of this study showed that bakery work was associated with a high frequency of work related allergic and respiratory symptoms. The symptoms particularly aggravate after exposure to wheat four and other allergens at the bakeries. PFT values were also significantly reduced among bakers compared to normal subjects indicating a permanent change of respiratory system in this occupational group.

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