

## Respiratory symptoms as health status indicators in workers at ceramics manufacturing facilities\*

Sintomas respiratórios como indicadores de estado de saúde em trabalhadores de indústrias de cerâmicas

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### Abstract

**Objective:** To assess the prevalence of respiratory symptoms and their association with sociodemographic variables and with the characteristics of the work environment. **Methods:** A cross-sectional study comprising 464 workers employed at ceramics manufacturing facilities located in the city of Várzea Grande, Brazil. Data were collected by means of a questionnaire comprising questions regarding sociodemographic variables, work environment characteristics, and respiratory symptoms. Data were analyzed by means of prevalence ratios and their respective 95% CIs between the dependent variable (respiratory symptoms) and the other explanatory variables. In the multivariate analysis, two hierarchical models were built, the response variables being “all respiratory symptoms” and “severe respiratory symptoms”. **Results:** In the sample studied, the prevalence of “all respiratory symptoms” was 78%, whereas that of “severe respiratory symptoms” was 35%. The factors associated with “all respiratory symptoms” were gender, age bracket, level of education, type of occupation, exposure to dust, and exposure to chemical products. The factors associated with “severe respiratory symptoms” were level of education, exposure to dust, and exposure to chemical products. **Conclusions:** Our results indicate the presence of upper and lower airway disease in the population studied.

**Keywords:** Questionnaires; Occupational diseases/epidemiology; Health status indicators.

### Resumo

**Objetivo:** Analisar a prevalência de sintomas respiratórios e sua associação com as características sociodemográficas e do ambiente de trabalho. **Métodos:** Estudo transversal realizado com 464 trabalhadores das indústrias de cerâmicas localizadas no município de Várzea Grande (MT). Para a coleta de dados, foi aplicado um questionário constituído de questões referentes às características sociodemográficas, ambiente de trabalho e sintomas respiratórios. Para a análise dos dados, foi utilizada a razão de prevalência e seu respectivo IC95% entre a variável dependente (sintomas respiratórios) e as demais variáveis explicativas. Na análise multivariada, foram construídos dois modelos hierárquicos, tendo como resposta as variáveis “sintomas respiratórios gerais” e “sintomas respiratórios graves”. **Resultados:** Na população estudada, a prevalência de “sintomas respiratórios gerais” foi de 78%, e aquela de “sintomas respiratórios graves” foi de 35%. Os fatores associados a “sintomas respiratórios gerais” foram sexo, faixa etária, escolaridade, ocupação, exposição à poeira e exposição a produto químico. Os fatores associados a “sintomas respiratórios graves” foram escolaridade, exposição à poeira e exposição a produto químico. **Conclusões:** Os resultados apontam para a presença de doenças da via aérea superior e inferior na população estudada.

**Descritores:** Questionários; Doenças profissionais/epidemiologia; Indicadores básicos de saúde.

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## Introduction

Air pollution in the work environment is associated with a wide variety of occupational respiratory diseases. Such diseases depend on various factors, among which are the effects of the pollutants themselves, the characteristics of the individual, and smoking. Occupational respiratory diseases can be investigated by a number of methods, including clinical tests, imaging studies, pulmonary function tests, and questionnaires for the identification of respiratory symptoms.<sup>(1)</sup>

Due to their ease of use and low cost, questionnaires are quite useful in epidemiological studies. In addition, questionnaires can be used to gather information regarding exposure to risk factors, to identify potential confounding or effect-modifying variables, and to identify diseases of interest. Therefore, in patients with occupational diseases, questionnaires can be used to determine the prevalence of respiratory symptoms and constitute a major epidemiological tool for establishing the diagnosis and assessing the evolution of lung disease in different population groups.<sup>(1,2)</sup>

Workers at ceramics manufacturing facilities are exposed to dust from raw materials, which is composed of hydrated aluminum silicates, which in turn are composed of layers of silicon dioxide tetrahedrons and aluminum octahedrons.<sup>(3)</sup> In addition, during the production process, these workers are at risk of inhaling chemical substances, such as the mold release agent (olein dissolved in diesel fuel), which is used to lubricate the machines that mold the tiles in the production line.

The poor air quality inside ceramics manufacturing facilities is caused by the dispersion of pollutants inside the factory plant and affects production line and administrative workers alike. Therefore, there is a need to determine whether the prevalence of respiratory symptoms is higher among workers who are directly exposed to the aforementioned risk factors. In this context, the objective of the present study was to assess, in workers at ceramics manufacturing facilities, the prevalence of respiratory symptoms and their association with sociodemographic variables, as well as with the characteristics of the work environment.

## Methods

This was a descriptive, cross-sectional study based on primary data and conducted in Várzea Grande, a city of 240,038 inhabitants,<sup>(4)</sup> located in the central-west region of Brazil, 6 km from Cuiabá, the capital of the state of Mato Grosso. There are currently 18 ceramics manufacturing facilities in the city. Of those, 3 specialize in manufacturing tiles and bricks, and the remaining 15 manufacture bricks only.

All of the production line and administrative workers who agreed to participate in the study were included. Data were collected by means of a questionnaire comprising questions regarding respiratory symptoms, occupational exposure, and smoking status. The questionnaire, designated "Respiratory Symptoms and Occupational Exposure to Inhaled Pollutants", is structurally based on the 1976 British Medical Research Council respiratory symptoms questionnaire and has been used by the *Fundação Jorge Duprat Figueiredo de Segurança e Medicina do Trabalho* (FUNDACENTRO, Jorge Duprat Figueiredo Foundation for Occupational Safety and Medicine), located in the city of São Paulo, Brazil. The questionnaire was administered in the work environment, during the lunch break, and each interview lasted 15 min on average.

Regarding smoking, the participants were categorized as follows: smokers—workers who had experimented with smoking and continued to smoke regularly; former smokers—workers who had previously been regular smokers; and nonsmokers—individuals who had never experimented with smoking (never smokers) or had done so but had not taken up the habit.

At the ceramics manufacturing facilities, the workers in the production area were divided into three categories: oven operator, production line operator, and general laborer. All of the workers in the administrative area were placed in a single category (administrative worker).

In order to evaluate the degree of exposure, we considered how long the workers had been working at the ceramics manufacturing facilities as oven operators, production line workers, or general laborers. This variable was categorized as follows:  $\leq 1$  year; 1–3 years; or  $\geq 3$  years.

The number of work hours per day was divided into two categories:  $\leq 8$  h; and  $> 8$  h.

The occupational risks were divided into two categories: dust—particulate matter from

the raw material (clay); and chemical product—the mold release agent, composed of olein and diesel fuel and used to lubricate the molds that shape the tiles, which combust when in contact with the hot plates of the machines, releasing smoke into the air.

Regarding the dependent variables, workers who reported that they presented at least one of the seven respiratory symptoms included in the questionnaire (dry cough, expectoration, wheezing, dyspnea, sneezing, rhinorrhea, and rhonchi) were considered to have “general respiratory symptoms”, whereas those who reported that they presented at least one of the three respiratory symptoms that indicated potential lower airway involvement (wheezing, dyspnea, and rhonchi) were considered to have “severe respiratory symptoms”.

For data tabulation and analysis, we used the programs Epi Info, version 6.04, and Statistical Package for the Social Sciences, version 11.0 (SPSS Inc., Chicago, IL, USA). In the bivariate analysis, we calculated the prevalence ratios (PRs) and

their respective 95% CIs between the dependent variable and the other explanatory variables studied. In order to determine the linearity of the associations, we used the chi-square test for linear tendency. For the multivariate analysis, we built two models, the response variables being “general respiratory symptoms” and “severe respiratory symptoms”. In that phase, the models included the variables that presented  $p \leq 0.10$  for explaining the differences between the presence or absence of respiratory symptoms and the remaining independent variables. The variables that presented no statistical significance ( $p > 0.05$ ) were excluded. By means of hierarchical logistic regression, the variables were grouped into blocks, using the conceptual hierarchical modeling proposed by Victoria et al.<sup>(5)</sup> The most distal factors (sociodemographic variables) were the first to be included; the intermediate factors (variables related to smoking) were then included; finally, the factors considered the closest to the outcome (variables related to the work environment, such as exposure to dust,

**Table 1** – Prevalence, prevalence ratios, and 95% CIs for general respiratory symptoms, according to the sociodemographic characteristics, in workers at ceramics manufacturing facilities in the city of Várzea Grande, Brazil, 2007.

Sociodemographic characteristics	Prevalence, n/N (%)	PR (95% CI)	p
<b>Gender</b>			
Female	54/84 (64)	1.00	
Male	308/380 (81)	1.26 (1.07-1.49)	< 0.001
<b>Age bracket</b>			
> 40 years	65/88 (74)	1.00	
20-40 years	257/325 (79)	1.07 (0.93-1.23)	0.295
< 20 years	40/51 (78)	1.06 (0.88-1.28)	0.545
<b>Race</b>			
Non-White	285/370 (77)	1.00	
White	77/94 (82)	1.06 (0.95-1.19)	0.306
<b>Marital status</b>			
Single	147/199 (74)	1.00	
Married	215/265 (81)	1.10 (0.99-1.22)	0.061
<b>Years of schooling</b>			
> 12 years	41/63 (65)	1.00	
9-11 years	81/117 (69)	1.06 (0.86-1.32)	0.569
≤ 8 years	240/284 (85)	1.30 (1.08-1.57)	< 0.001
<b>Per capita income</b>			
> 1 × the national minimum wage	20/29 (69)	1.00	
≤ 1 × the national minimum wage	342/435 (79)	1.14 (0.89-1.46)	0.224
<b>Number of people in the household</b>			
≤ 3 people	244/316 (77)	1.00	
> 3 people	118/148 (80)	1.03 (0.93-1.14)	0.542

PR: prevalence ratio.

exposure to the chemical product, and the type of occupation) were included.

The research project was approved by the Research Ethics Committee of the Júlio Muller University Hospital (protocol no. 320/7/HJUM/07).

## Results

Of the 464 workers interviewed, 78% presented with general respiratory symptoms, and 35% presented with severe respiratory symptoms. Sneezing (58%) and dry cough (40%) were the most prevalent symptoms.

Table 1 shows the prevalence, PRs, and 95% CIs for general respiratory symptoms, according to the sociodemographic characteristics. Respiratory symptoms were more prevalent among males (81%), who were 26% more likely to present with respiratory symptoms than were females. Workers who had had 8 or fewer years of schooling were more likely to present with general respiratory symptoms than were those who had had more than 8 years of schooling (PR = 1.30; 95% CI: 1.08-1.57). The variables "race", "marital status", "per capita income", and "number of people living in the household"

showed no association with the outcome studied ( $p > 0.05$ ).

The prevalence of general respiratory symptoms was highest among production line operators (83%), who were 46% more likely to present with symptoms than were administrative workers (PR = 1.46; 95% CI: 1.14-1.87). Likewise, general laborers and oven operators were more likely to present with general respiratory symptoms than were administrative workers ( $p < 0.05$ ). As can be seen in Table 2, workers exposed to dust or to the chemical product were more likely to present with general respiratory symptoms than were those who had no contact with those substances (PR = 2.10; 95% CI: 1.72-2.57 and PR = 1.15; 95% CI: 1.14-1.37, respectively).

Regarding severe respiratory symptoms, only the level of education was shown to be associated with such symptoms, which means that the probability of presenting with symptoms was more than twice as high among workers who had had 8 or fewer years of schooling as was that among those who had had more than 8 years of schooling (Table 3).

As can be seen in Table 4, workers who had contact with dust were 3 times more likely

**Table 2** - Prevalence, prevalence ratios, and 95% CIs for general respiratory symptoms, according to the characteristics of the work environment, in workers at ceramics manufacturing facilities in the city of Várzea Grande, Brazil, 2007.

Characteristics of the work environment	Prevalence, n/N (%)	PR (95% CI)	p
Type of occupation			
Administrative worker	33/58 (57)	1.00	
Production line operator	69/83 (83)	1.46 (1.14-1.87)	< 0.001
General laborer	210/260 (81)	1.42 (1.13-1.79)	< 0.001
Oven operator	50/63 (79)	1.39 (1.08-1.80)	0.007
Length of exposure			
< 1 year	136/182 (75)	1.00	
1-3 years	113/137 (82)	1.10 (0.98-1.24)	0.097
> 3 years	113/145 (78)	1.04 (0.92-1.18)	0.499
Number of work hours per day			
≤ 8 h	272/355 (77)	1.00	
> 8 h	90/109 (83)	1.08 (0.97-1.20)	0.189
Substances inhaled			
Dust			
No	55/127 (43)	1.00	
Yes	307/337 (91)	2.10 (1.72-2.57)	< 0.001
Chemical product			
No	206/289 (71)	1.00	
Yes	156/175 (90)	1.15 (1.14-1.37)	< 0.001

PR: prevalence ratio.

to present with severe respiratory symptoms. Likewise, workers who had contact with the chemical product were 67% more likely to present with severe respiratory symptoms. The variables “length of exposure” and “number of work hours per day” showed no significant association with the severe respiratory symptoms studied ( $p > 0.05$ ).

The multivariate analysis showed that gender, age bracket, and years of schooling remained associated with general respiratory symptoms, which means that male workers 40 years of age or younger (OR = 1.84; 95% CI: 1.04-2.35) who had had 8 or fewer years of schooling (OR = 1.64; 95% CI: 1.64-4.16) were more likely to present with general respiratory symptoms. The risk of presenting with general respiratory symptoms was highest among general laborers and production line operators. In addition, workers who had contact with dust were 12 times more likely to present with general respiratory symptoms than were administrative workers (OR = 12.39; 95% CI: 6.72-22.86).

The model including severe respiratory symptoms as the outcome showed that workers who had had 8 or fewer years of schooling were nearly 2 times more likely to present with severe respiratory symptoms than were those who had had more than 8 years of schooling (OR = 1.97; 95% CI: 1.26-3.06). As shown in Table 5, workers who had contact with dust were over 3 times more likely to present with severe respiratory symptoms than were those who had no such contact (OR = 3.36; 95% CI: 1.86-6.07). Likewise, workers who had contact with the chemical product were more likely to present with severe respiratory symptoms than were those who had no such contact (OR = 1.76; 95% CI: 1.15-2.70).

## Discussion

In the present study, the prevalence of “general respiratory symptoms” was 78%, which is high.<sup>(6)</sup> The symptoms investigated were similar to those investigated in other studies,<sup>(7)</sup>

**Table 3** – Prevalence, prevalence ratios, and 95% CIs for severe respiratory symptoms, according to the sociodemographic characteristics, in workers at ceramics manufacturing facilities in the city of Várzea Grande, Brazil, 2007.

Sociodemographic characteristics	Prevalence, n/N (%)	PR (95% CI)	p
<b>Gender</b>			
Female	27/84 (32)	1.00	
Male	134/380 (35)	1.10 (0.78-1.54)	0.586
<b>Age bracket</b>			
> 40 years	26/88 (30)	1.00	
20-40 years	118/325 (36)	1.23 (0.86-1.75)	0.237
< 20 years	17/51 (33)	1.13 (0.68-1.87)	0.641
<b>Race</b>			
Non-White	125/370 (33)	1.00	
White	36/94 (38)	1.13 (0.85-1.52)	0.411
<b>Marital status</b>			
Single	60/199 (30)	1.00	
Married	101/265 (38)	1.26 (0.97-1.64)	0.074
<b>Years of schooling</b>			
> 12 years	10/63 (16)	1.00	
9-11 years	33/117 (28)	1.78 (0.94-3.36)	0.064
≤ 8 years	118/284 (42)	2.62 (1.46-4.70)	< 0.001
<b>Number of people in the household</b>			
≤ 3 people	108/316 (34)	1.00	
> 3 people	53/148 (36)	1.05 (0.80-1.36)	0.730
<b>Per capita income</b>			
> 1 × the national minimum wage	6/29 (21)	1.00	
≤ 1 × the national minimum wage	155/435 (36)	1.72 (0.84-3.55)	0.101

PR: prevalence ratio.

**Table 4** – Prevalence, prevalence ratios, and 95% CIs of severe respiratory symptoms, according to the characteristics of the work environment, in workers at ceramics manufacturing facilities in the city of Várzea Grande, Brazil, 2007.

Characteristics of the work environment	Prevalence, n/N (%)	PR (95% CI)	p
Type of occupation			
Administrative worker	11/58 (19)	1.00	
Production line operator	28/83 (34)	1.78 (0.97-3.28)	0.053
General laborer	22/63 (35)	1.84 (0.98-3.46)	0.048
Oven operator	100/260 (38)	2.03 (1.17-3.53)	0.004
Length of exposure			
< 1 year	57/182 (31)	1.00	
1-3 years	51/137 (37)	1.29 (0.88-1.61)	0.269
> 3 years	53/145 (36)	1.17 (0.86-1.58)	0.319
Number of work hours per day			
≤ 8 h	118/355 (33)	1.00	
> 8 h	43/109 (39)	1.19 (0.90-1.56)	0.233
Substances inhaled			
Dust			
No	17/127 (13)	1.00	
Yes	144/337 (43)	3.19 (2.02-5.05)	< 0.001
Chemical product			
No	80/289 (28)	1.00	
Yes	81/175 (46)	1.67 (1.31-2.14)	< 0.001

PR: prevalence ratio.

in which cough was reported to be the most prevalent symptom among workers exposed to silica dust. Cough is a defense mechanism that promotes the removal of secretion and foreign bodies from the airways and is a symptom that must be investigated.<sup>(8)</sup>

In the present study, the prevalence of general respiratory symptoms was associated with the male gender. Logistic regression, which allowed a more in-depth analysis of the association between gender and the prevalence of general respiratory symptoms, showed that male workers were nearly 2.5 times more likely to present with such symptoms than were female workers. The high proportion of males employed at ceramics manufacturing facilities is due to the fact that most of the activities performed at such facilities involve manual labor, which is more commonly sought by males than by females.

Contrary to what was expected, the prevalence of general respiratory symptoms was higher among individuals ≤ 40 years of age. These results differ from those of other studies, which showed that the prevalence of respiratory symptoms increases with age.<sup>(9,10)</sup> In addition to the healthy worker effect, this probably occurred because younger workers are more commonly

sought for this type of job due to their greater strength and vigor.

The variable “years of schooling” was shown to be associated with the presence of general respiratory symptoms. Individuals with a low level of education have limited job opportunities and are forced to accept low-paying jobs, many of which pose health risks. These results are in accordance with those of other studies, which reported that a low level of education is associated with the presence of respiratory symptoms.<sup>(10,11)</sup>

We found that the variable “type of occupation” was associated with the presence of general respiratory symptoms. The workers categorized as production line operators, general laborers, or oven operators were at a higher risk of presenting with respiratory symptoms than were those categorized as administrative workers. A study conducted at marble manufacturing facilities<sup>(6)</sup> showed that the prevalence of respiratory symptoms was higher among workers who had been exposed to greater quantities of dust.

In the present study, the variables “length of exposure” and “number of work hours per day” showed no association with the presence

**Table 5** – Adjusted OR and 95% CIs of the factors associated with general and severe respiratory symptoms in workers at ceramics manufacturing facilities in the city of Várzea Grande, Brazil, 2007.

Variables	OR (95% CI)	p
General respiratory symptoms		
Level 1		
Gender		
Female/Male	2.23 (1.31-3.82)	0.003
Age bracket		
≤ 40 years/> 40 years	1.84 (1.04-3.25)	0.036
Years of schooling		
≤ 8 years/> 8 years	2.61 (1.64-4.16)	< 0.001
Level 2		
Type of occupation		
Oven operator/Administrative worker	1.59 (0.69-3.68)	0.277
General laborer/Administrative worker	2.93 (1.04-8.25)	0.042
Production line operator/Administrative worker	3.99 (1.29-12.37)	0.016
Substances inhaled		
Dust		
Yes/No	12.39 (6.72-22.86)	< 0.001
Chemical product		
Yes/No	1.78 (0.92-3.47)	0.088
Severe respiratory symptoms		
Level 1		
Years of schooling		
≤ 8 years/> 8 years	1.97 (1.26-3.06)	0.027
Level 2		
Substances inhaled		
Dust		
Yes/No	3.36 (1.86-6.07)	< 0.001
Chemical product		
Yes/No	1.76 (1.15-2.70)	0.003

of general respiratory symptoms. Once again, the healthy worker effect, in combination with the short length of exposure (less than 1 year) of “healthy” workers to the risk factors (such as inhalation of dust and chemical product), might partially explain these results. These data differ from those from other studies, which reported that the length of exposure to agents in the work environment is related to the presence of respiratory symptoms and of changes in lung function.<sup>(2,6,12)</sup>

In the present study, the occupational exposure factors (dust and chemical product) were shown to be associated with the presence of general respiratory symptoms. The workers who reported inhaling dust during their work hours were 12.4 times more likely to present with general respiratory symptoms than were those who reported not having inhaled dust.

In the course of their work activities, workers at ceramics manufacturing facilities are directly or indirectly exposed to various risk factors for respiratory diseases, among which are dust from the raw material or from the products manufactured and the chemical product (mold release agent), which is composed of olein dissolved in diesel fuel. A study of construction workers showed that the dust inhaled during working hours is solid particulate matter (respirable dust), which is known to cause severe respiratory damage, such as pneumoconiosis and lower airway involvement.<sup>(13)</sup>

In addition to the dust present in all sectors of the ceramics manufacturing facilities, production line operators directly inhale the chemical product (i.e., the mold release agent). The workers who inhaled the mold release agent were 1.8 times more likely to present with

general respiratory symptoms than were those who did not. Contact occurs when the product is used to lubricate the molds of the machines that shape the tiles or when the agent combusts after having been heated by the machine plates, releasing in the air numerous toxic substances (products derived from the combustion of the petroleum derivative),<sup>(14)</sup> which enter the airways directly, because most of the workers do not use respiratory protection equipment while at work.

Because the prevalence of respiratory symptoms in the present study was extremely high, we decided to conduct a more in-depth analysis of the symptoms that truly indicated greater severity, that is, those related to lower airway involvement. Dyspnea, wheezing, and rhonchi were considered severe respiratory symptoms, the prevalence of which was 35%. A study conducted in order to analyze the prevalence of and risk factors for severe respiratory symptoms in pig farmers<sup>(11)</sup> showed that 31% of the population exposed to various risk factors in the work environment, including dust, presented with such symptoms.

The presence of the abovementioned symptoms is known to be associated with respiratory disease, which increases the concern. It is possible that the workers with symptoms that are more severe have respiratory diseases, with lower airway involvement.

The principal occupational diseases that can be related to the symptoms analyzed in the present study are occupational asthma, COPD, and pneumoconioses, especially silicosis and asbestosis.<sup>(12,15)</sup>

Unlike the analysis that included all of the symptoms studied, the analysis of the relationship between the prevalence of severe respiratory symptoms and the sociodemographic variables showed no positive association with gender. However, in workers who had had 8 or fewer years of schooling, the association persisted, a finding that is in accordance with those of other studies, which reported an association between a low level of education and the presence of respiratory symptoms.<sup>(12,16)</sup>

The variables related to the characteristics of the work environment were shown to be associated with the prevalence of severe respiratory symptoms. The type of occupation is directly related to the presence of such symptoms, because the workers who are in the

production front line, manipulating all of the products manufactured at the facilities, are the most affected; general laborers present with more symptoms than do oven operators, who present with more symptoms than do production line operators. It is possible that workers who have such jobs come into direct contact with the respiratory pollutants that affect the integrity of the lower airways and therefore present with severe respiratory symptoms more commonly than do workers who have other jobs. In the present study, this was confirmed by the analysis of the association between the presence of severe respiratory symptoms and the reported exposure to dust. The analysis revealed that those who inhaled dust were over 3 times more likely to present with severe respiratory symptoms.

Another exposure factor investigated in the present study was the reported exposure to the mold release agent, a product used to lubricate the tile molds. Severe respiratory symptoms were more common among workers who reported being exposed to the mold release agent than among those who denied being exposed to the agent. However, the analysis showed that the association between severe respiratory symptoms and exposure to the agent was weaker than was that observed between severe respiratory symptoms and exposure to dust. It should be highlighted that the manipulation of petroleum derivatives releases into the room air various other substances that volatilize easily and impair the respiratory system of workers.

In addition to their topical toxicity, which affects the respiratory mucous membranes, such chemical pollutants interfere with alveolar hematosis, which can affect tissue oxygenation. The combustion of the mold release agent, which comes into contact with the heated molds, releases smoke that further pollutes the air that is inhaled, which explains the presence of symptoms that are more severe, such as dyspnea, in those workers.<sup>(17)</sup>

Exposure to petroleum derivatives can affect the airways in various ways, depending on the physical, chemical, and biological properties of the pollutants that are formed; the size/concentration of the particles inhaled and concomitant exposure can be risk factors for various diseases, such as asthma, sinusitis, rhinitis, perforation of the nasal septum, and altered sense of smell.<sup>(2,18)</sup>



We found no association between the prevalence of severe respiratory symptoms and the length of exposure to the various pollutants (number of years working at ceramics manufacturing facilities and number of work hours per day). This might be attributable to the fact that most workers had been working in high-risk occupations at ceramics manufacturing facilities for a short time (less than 1 year). It is known that a greater length of exposure to the risk factors (inhaled pollutants) translates to a greater chance of developing respiratory diseases.<sup>(6)</sup> The results of the present study differ from those of other studies,<sup>(7,13)</sup> in which the length of exposure contributed to the onset of respiratory disease and silicosis, exposure to silica dust for 5 years or more being sufficient to provoke the disease.

In the present study, we found no association between severe respiratory symptoms and smoking, which is a risk factor for respiratory disease. In a study involving former workers with asbestosis,<sup>(19)</sup> smoking was not associated with severe respiratory symptoms, principally dyspnea. However, most studies have reported an association between severe respiratory symptoms and smoking, which is an aggravating factor for occupational respiratory diseases.<sup>(16,20)</sup> The short length of the smoking habit, mild dependence, and age bracket in the study population partially explain this finding.

Although the instrument used in the present study did not allow us to measure the degree of respiratory dysfunction, we conclude that the work environment at the ceramics manufacturing facilities under study is causing damage to the respiratory system of the workers that constituted the study population, with upper and lower airway involvement (symptoms that are considered severe).

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