

# Lung Function of Traditional Bakers and Pastry Makers Exposed to Flour Dust in the City of Thies, Senegal

Arame Mbengue<sup>1</sup>, Mame Saloum Coly<sup>2</sup>, Mor Diaw<sup>3</sup>, Abdou Khadir Sow<sup>3</sup>, Salimata Houndjo Faye<sup>4</sup>,  
Fatou Bintou SAR<sup>1</sup>

<sup>1</sup>Professor, <sup>2</sup>Assistant Professor, Laboratory of Physiology, UFR of Health Sciences of Thies, Service Functional Explorations of the Regional Hospital of Thies, Senegal, <sup>3</sup>Senior Assistant Professor, <sup>4</sup>Assistant Professor, Laboratory Physiology and Functional Explorations, FMPO/UCAD, Dakar, Senegal

## Abstract

**Introduction:** Cases of restrictive and obstructive diseases have been reported in workers exposed to flour dust. In Senegal, studies on the lung function of bakery-pastry employees are rare. The purpose of our study was to evaluate the clinical respiratory manifestations and ventilatory disorders (VD) related to flour dust exposure among traditional bakers and pastry makers in the city of Thies, Senegal.

**Materials and Method:** A descriptive cross-sectional study was conducted. Forty subjects were recruited. Subjects received a basic and post-bronchodilator spirometry. The targeted respiratory functional disorders were bronchial obstruction, functional restriction and mixed syndrome.

**Results:** The average length of service at the workplace was  $7\pm 6,7$  years. Smokers represented 17,5%. A respiratory symptoms were found in 65% of our subjects. Coughing, sneezing and rhinorrhea were more frequent with 50%, 24% and 17% respectively. The most common ventilatory disorders among exposed bakers were of the mixed type (22,5%). On the other hand, 12,5% had an isolated obstructive ventilatory disorder (OVD) and a restrictive functional disorder (RFD) was found in 10%. The obstructive ventilatory disorders were dominated by obstruction of the small airways (80%). The severity of ventilatory disorders was of a moderate deficit type (87% and 62% respectively). Respiratory function abnormalities were more common in the smokers with a prevalence of ventilatory disorders that increased with age of employment. However, the effect of exposure appears to be clear because among non-smokers, 12,13 % of the exposed patients had respiratory functional abnormalities with isolated restrictive functional disorder type.

**Conclusion:** This study showed that bakery and pastry workers have various respiratory symptoms and ventilatory disorders. Smoking and job tenure remain factors that increase these flour dust-related risks.

**Keywords:** bakery, flour dust, respiratory symptoms, spirometry, ventilatory disorders.

## Introduction

Traditional bakers and pastry makers are exposed to flour dust every day, various irritant chemicals and the heat generated during baking. In 1713, Ramazzini reported for the first time otolaryngological and

bronchial manifestations in bakers<sup>1</sup>. Since then, a lot of studies have shown that exposure to flour dust causes respiratory symptoms and is associated with impaired lung function<sup>2,3</sup>. The respiratory symptoms are thus common among workers exposed to organic dust. These are often complex and can contain different types of materials from animals and plants. Furthermore, they can cause lung diseases such as work-related asthma, chronic bronchitis and allergic alveolitis<sup>4</sup>. Obstructive and restrictive respiratory diseases have been reported in grain handlers and bakery workers in other parts of the world<sup>5</sup>. In Senegal, respiratory risks are probably

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### Corresponding Author:

**Arame Mbengue,**  
Department of Biology, UFR of Health Sciences,  
University of THIES, SENEGAL,  
email: aramembengue08@live.fr

higher because working conditions are very hard and individual and collective preventive measures are absent in this professional sector. The purpose of our work was to evaluate the clinical respiratory symptoms and ventilatory disorders related to flour dust exposure in traditional bakers and confectioners in the city of Thies.

## Materials and Method

A cross-sectional descriptive study was conducted from november 2018 to february 2019 after approval of the study protocol by the ethics committee of the University of Thies.

### Study population

The study population whose free and informed consent was obtained, consisted of 40 bakers, all male, with at least one year's seniority in the profession. Subjects who had a refusal to participate or a known progressive cardiopulmonary pathology were not included in our study.

### Method

The study included a medical survey with a questionnaire that examined physical characteristics, seniority, smoking habits, respiratory symptoms and atopic history. The subjects are categorized as smokers: those who smoked during the 30 days preceding the survey, former smokers: those who smoked for more than 30 days but did not smoke during the 30 days preceding the survey; non-smokers are those who had never smoked or who had smoked for less than 30 days. All our subjects received a complete physical test and then a basic and post-bronchodilator spirometry using a *Jaeger PNEUMO CareFusion* brand spirometer. Lung volumes and bronchial flows were examined and the rates of variation of the different parameters with respect to the reference standards were taken into account (ERS/ATS 2005). The parameters measured were the Forced Expiratory Volume at the first Second (FEV1), the Forced Vital Capacity (FVC), the Tiffeneau ratio (FEV1/FVC) and the maximum expiratory flow rate 25-75% (FEF<sub>25-75%</sub>). We have defined a restrictive function disorder on the basis of a decrease in vital capacity (VC) of less than 80% and a normal FEV1/FVC ratio (>80%). The obstructive ventilatory disorder is defined by a measured FEV1/FVC ratio of less than 80% of the theoretical value. Small airway obstruction has been defined by a FEV1/FVC ratio of more than 80% and a FEF<sub>25-75%</sub> of less than 80% of the theoretical value. FEV1 and FVC

quantify the importance of obstructive or restrictive syndrome according to the following classification: mild ventilatory disorder ( $70 \leq \text{FEV1}$  or  $\text{VC} < 80\%$ ), moderate ventilatory disorder ( $50\% \leq \text{FEV1}$  or  $\text{VC} < 70\%$ ), severe ventilatory disorder ( $30\% \leq \text{FEV1}$  or  $\text{VC} < 50\%$ ) and very severe ventilatory disorder ( $\text{FEV1}$  or  $\text{VC} < 30\%$ )<sup>6</sup>. In case of obstructive syndrome, a reversibility test was performed 15 minutes after inhalation of 400 mg of salbutamol. The mixed syndrome was retained in front of the association of the two obstructive and restrictive spirometric anomalies<sup>7</sup>.

## Statistical Analysis

The data were entered and analyzed using Excel software version 2013. The percentage averages and standard deviations were determined for the quantitative parameters. The Student test made it possible to compare the average. Correlations were also searched using the Pears on Test. The significance rate was a p-value < 0.05.

## Results

### Working conditions and work-related exposure

The bread making rooms were mostly poorly ventilated with a very hot environment due to the heat released by the oven during the baking and the lack of a ventilation system. Moreover, these locations served as dormitories for some employees during their off-duty hours. Our subjects worked an average of  $48 \pm 22$  hours per week extremes ranging from 18 to 105 hours/week. The majority of our bakers (58%) worked between 30 and 60 hours a week. However, 27% of the subjects had a weekly working time of more than 60 hours and only 15% worked less than 30 hours per week. Thus, all these working conditions contributed to exposure to air contaminants in rooms that are often crowded, badly maintained and poorly ventilated.

### General characteristics of the population

Our results showed that our subjects were  $26 \pm 10$  years old with an average BMI of  $21,22 \pm 3,57$  kg/m<sup>2</sup>. The average length of service in the workplace was  $7 \pm 6,7$  years (Table 1). Smokers represented 17,5% of our study population.

### Prevalence of respiratory symptoms

Respiratory symptomatology was found in 65% of our subjects, 25% of whom had presented a notion of atopy. Coughing, sneezing and rhinorrhea were

more common with 50%, 24% and 17% respectively (Figure1).

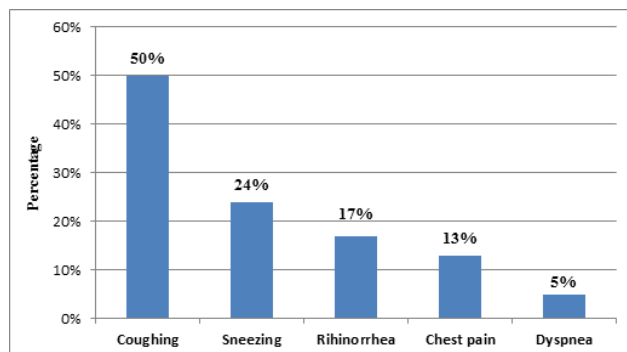
**Prevalence of ventilatory abnormalities**

The most common ventilatory disorders in exposed subjects were of the mixed type, (22,5%). On the other hand, 12,5% of the subjects had pure obstructive ventilatory disorders and a restrictive functional disorder was found in 10% of the cases (Figure 2). The obstructive ventilatory disorders were dominated by a small airway syndrome (80%). The severity of obstructive or restrictive ventilatory disorders was of a moderate deficit type (87% and 62% respectively). The prevalence of ventilatory abnormalities were higher in the smokers (mixed ventilatory disorder 38,57% vs 21,21%) and increased significantly along with seniority in the post (p=0.0001 for the mixed ventilatory disorder) (Figure3). The effect of exposure to flour dust appears to be clear because 12,13% of the non-smokers had respiratory functional abnormalities with an isolated restrictive functional disorder. However, 10% of work-related asthma cases were found in our study population.

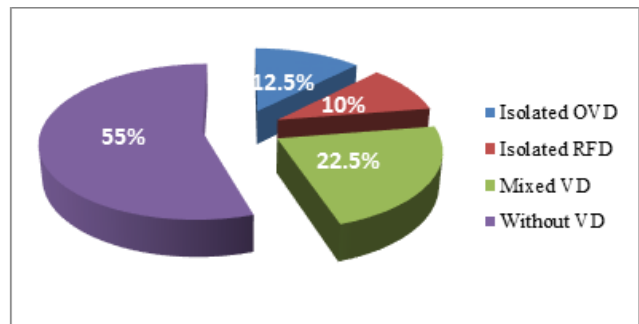
**Table 1: General characteristics of the study population.**

Anthropometric data	Average	Min	Max
Age (years)	26.15 ± 10.18	15	52
Weight (kg)	68.30 ± 10.97	51	95
Height (cm)	179.42 ± 8.08	150	195
BMI (kg/m <sup>2</sup> )	21.22 ± 3.57	16	30
Waist size (cm)	74.95 ± 9.08	61	95
Seniority (years)	7 ± 6.7	1	25

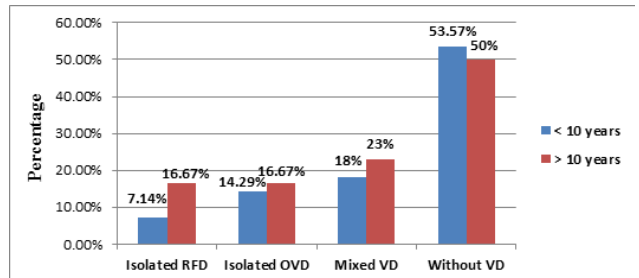
BMI : Body mass index



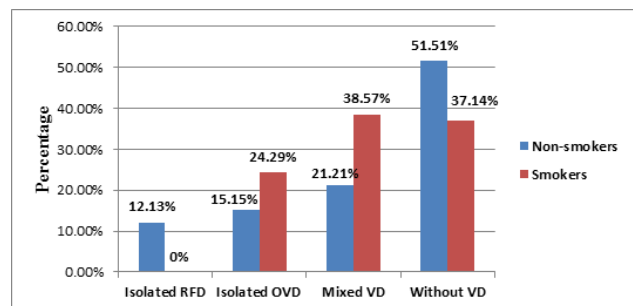
**Figure 1: prevalence of respiratory symptoms.**



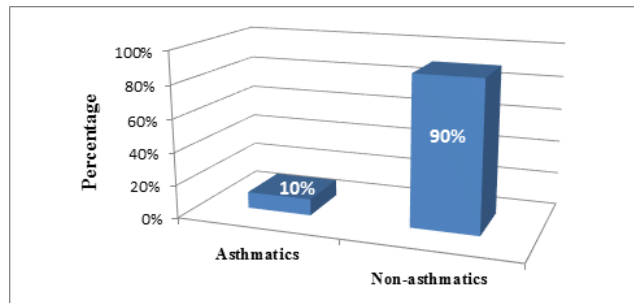
**Figure 2: prevalence of ventilatory abnormalities.**



**Figure 3: distribution of VD according to seniority (years).**



**Figure 4: distribution of VD by smoking status.**



**Figure 5: Prevalence of asthma in our study population.**

**Discussion**

This study made it possible to identify the main work-related risks of the bakery and pastry profession that are part of the informal economy in our country. Our recruited subjects did not receive medical follow-up and did not use any personal protective equipment against flour dust during the exercise of their profession. However, bakers' lack of protective measures could be linked, on the one hand, to a failure by employers and, on the other hand, to ignorance of the health risks incurred due to the low levels of education combined with a lack

of adequate training. This is consistent with observations made by Hentschel et al.<sup>8</sup> in other job categories where workers are exposed to dust.

### ***General characteristics of the population***

Our study population was relatively young (average age 26±10 years). The age distribution does not differ from the traditional demographic characteristics of African countries. The proportion of workers with less than 5 years' professional experience predominated, i.e. 45% of the subjects. This observation was also made by Aba<sup>9</sup> who found 59.9% of workers with less than 5 years' seniority respectively among carpenters. Seniority is a determining work-related risk factor in the occurrence of certain pathologies related to exposure to organic dust. In fact, young workers lack experience and do not sufficiently control the risks associated with the different activities they carry out. In Senegal, there are currently no specific recommendations concerning the exposure limit value for flour dust in relation to the exposure threshold of 10 mg/m<sup>3</sup> for harmful dust<sup>10</sup>.

### ***Clinical respiratory manifestations***

Our study revealed the presence of a large number of complaints among bakers and pastry makers with a clear predominance of cough (50%), sneezing (24%) and rhinorrhea (17%). Backlate et al.<sup>11</sup> similarly observed that coughing, mucus production, wheezing and dyspnea were acute symptoms of exposure to flour dust. Sneezing and rhinorrhea are the most common symptoms in the studies of Ige et al.<sup>12</sup> and Backlake et al.<sup>11</sup>. Flour has been implicated in triggering symptoms in 65% of our bakers. Our results corroborate those of Laraqui et al.<sup>13</sup> who observed that workers exposed to cereal dust handling large quantities of grain daily and without any means of personal protection were more symptomatic (64.3%) than unexposed subjects. Tabka et al.<sup>14</sup>, in a cross-sectional study on respiratory pathology related to cereal dust in the Sousse region (Tunisia) made the same observations, suggesting that these clinical manifestations depend on the level of dusting.

Several surveys among bakers in Europe have reported lower prevalences than those found in our study: 14 to 17% for Vanhanen et al.<sup>15</sup>, 19% for Prichard et al.<sup>16</sup>. These studies concerned more modern bakeries where hygiene conditions and methods of individual and collective technical prevention were better. The relatively small number of exposed subjects in our study (40 bakers) may contribute to underestimate the

importance of the problem.

In our study, the prevalence of 25% of atopic subjects would be due to the lack of orientation of young atopic people towards respiratory risk-free jobs, and to the absence of work-related medical services. Its prevalence in the literature is so differently assessed: 16% for Vanhanen et al.<sup>15</sup>, 38% for Houba et al.<sup>17</sup>. This discrepancy may be related to the definition of atopy in the methodologies of surveys based on the questionnaire only.

### ***Spirometric parameters***

In our study, the abnormalities of ventilatory function are very important, accounting for 45% of our subjects. The prevalence of ventilatory abnormalities in other Moroccan studies was 31,6% among mill workers<sup>18</sup>. These changes in respiratory function would probably be caused by airway obstruction due to bronchoconstriction in response to flour dust. The healthy worker effect would explain that ventilatory disorders were more of an obstructive type characterized by small airway damage with a moderate degree of obstruction. Indeed, workers with severe disorders were not present at the time of the survey because they had left the profession on their own or were on sick leave.

The combination of tobacco and exposure to organic dusts impairs respiratory function with effects that potentiate, add up or multiply. In our study, we found that work-related exposure associated with smoking leads to an increase in respiratory functional disorders (Figure 4). Cotton et al.<sup>19</sup> in a study conducted in cereal workers showed lower spirometric values in exposed and smokers. This finding suggests an interaction between tobacco and work-related exposure in the development of ventilatory abnormalities. In another study, comparing a group of cereal workers to a control group, the same authors found an increase in the prevalence of symptoms and a decrease in respiratory function values in the exposed and smoking group, but in this study, these effects appeared to be more than synergistic<sup>20</sup>. Moreover, our study found a relationship between the observed ventilatory disorders and seniority in this activity. Variations in ventilatory parameters in the bronchodilation test showed 10% of asthmatic subjects. Many cross-sectional studies have reported asthma prevalence in bakers ranging from 5 to 21%<sup>21</sup>. These differences in results can be explained by the type of bakeries (artisanal or industrial), the level of



dust (presence or absence of effective prevention or ventilation measures) and the criteria for defining asthma that vary from one study to another.

### Conclusion

This study showed that bakers and pastry makers exhibit various respiratory symptoms and ventilatory disorders related to the constant inhalation of flour dust during the course of their work. Poor working conditions and the premises housing these bakeries and pastry factories thus favour the occurrence of these work-related risks. Smoking and seniority in the profession increase these functional anomalies related to dust. The strengthening and implementation of individual and collective preventive measures remain a priority for better health for these workers.

**Ethical Clearance:** Ethics committee of the University of Thies.

**Source of Funding - Self**

**Conflict of Interest:** Nil

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