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# Respiratory Function Profile of Workers Exposed to Clinker Dust in the Autonomous Port of Conakry

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**ABSTRACT**

**Introduction**: Pulmonologists are regularly confronted with the medical and medico-legal management of these conditions [2]. The objective of our study was to describe the respiratory functional profile of workers exposed to clinker dust at the Autonomous Port of Conakry.

**Methods:** This was a 12-month descriptive cross-sectional study that took place from 1 November 2022 to 31 October 2023.

**Results:** The average age of workers was 40 years, with extremes of 20 and 72 years. Among smokers, we reported that 93% smoked less than 10PA. The average duration of exposure in our study was 10.47 ± 5.16 years. Cough was the main symptom (38% dry and 36% productive), followed by melanoptysia (14%). Physical signs were poor and auscultation was normal in 86.6% of cases. Frontal chest X-ray was found to be pathological in 10.05%. The evaluation of respiratory function allowed us to detect restriction in 35.40% of cases and obstruction in 5.26% of cases. We noted a 1.07% improvement in FEV1 upon return from the holidays. We have no evidence that exposure to clinker dust is the cause of the decline in workers' respiratory function.

**Conclusion:** Thanks to spirometry, we were able to detect obstructive and restrictive ventilatory disorders in almost half of the cases. Thus, to protect workers, technical and medical preventive measures and clinical as well as radiological and spirometric monitoring are necessary. .

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**KEYWORDS:**

clinker pneumoconiosis, ILO, Autonomous Port of Conakry, SNMT.

## INTRODUCTION

Pneumoconiosis is defined as changes caused by the inhalation and deposition of mineral dust in the lungs, which can lead to fibrosis **[1].** Pulmonologists are regularly confronted with the medical and medico-legal management of these conditions **[2]**. Workers exposed to various industrial toxins (dust, fumes and gases) are prone to respiratory diseases [**3].**

An estimated 2.34 million people die each year from work-related diseases and accidents. The types and trends of diseases observed vary widely. For example, of the 27,240 cases of occupational diseases reported in China in 2010, 23,812 were the result of exposure to dust in the workplace **[4].** In China, pneumoconiosis accounts for more than 80% of all cases; in recent years, 10,000 to 23,000 new cases have been reported annually [**5].** In 2011, Japan recorded a total of 7,779 cases of occupational diseases, mainly related to low back pain and pneumoconiosis [**3].** In the United Kingdom, 5,920 cases of occupational diseases resulted in compensation in 2011, with the three most common diseases being pneumoconiosis, diffuse mesothelioma and osteoarthritis [**6].** In the United States, the Bureau of Labour Statistics reported that 207,500 workers suffered from non-fatal occupational diseases in 2011, with skin diseases, hearing loss and respiratory conditions being the most prevalent health problems [**7].** In mining and quarrying, construction and other manufacturing industries, millions of workers are still at risk of developing pneumoconiosis (including silicosis, miners' pneumoconiosis and asbestos-related diseases) due to widespread exposure to silica, coal, asbestos and various

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mineral dusts. In India, approximately 10 million workers employed in mining, construction and various other sectors are exposed to silica dust. Epidemiological studies show that in developing countries, 30 to 50% of workers in the primary sector and high-risk industries may be affected by silicosis and other pneumoconioses [**9].** The World Health Organisation (WHO) is sounding the alarm about the devastation caused by occupational diseases. According to the same organisation, the number of workers dying every day from work-related diseases "is in the hundreds". The WHO also adds that between 40 and 50% of the global working population is exposed to occupational health risks, and the situation is getting worse, with nearly 68 million new cases appearing each year. In the same vein, another report published by the International Labour Organisation (ILO) highlights the seriousness of the problem in developing countries [**2].** The cement industry is a source of environmental pollution. During the various stages of cement production, dust and particles are released. It is estimated that occupational exposure to airborne particles causes 16% of deaths worldwide each year due to chronic obstructive pulmonary disease (COPD). In addition, approximately 519,100 deaths in 2016 were attributed to exposure to silica, coal dust and asbestos each year worldwide [**3].** Respirable crystalline silica dust or quartz (smaller than beach sand and pollen) is released into the air during high-energy cutting, drilling or grinding processes involving stone, rock, concrete and mortar. Breathing in silica dust can have harmful effects on human health [**3].** Cement is widely used, not only in the construction and public works industries, but also by the general public. It is a material composed of 80% limestone and 20% clay. The basic component of almost all cements is Portland clinker (a mixture of different raw materials that has been fired) [**5].** The cement industry has grown significantly in recent years in Guinea, increasing demand for raw materials and leading to imports of Portland clinker. Port activities involving the unloading of ships containing clinker expose workers in the sector to an increased risk of inhaling large amounts of dust, including clinker. No studies have yet been conducted on this subject in Guinea. Does exposure to clinker dust impair the respiratory function of workers?

## MATERIALS AND METHODS

**Study setting :** Our study was conducted in the autonomous port of Conakry. It is the country's main port. It has been growing steadily since the arrival of a foreign concessionaire, making it more competitive internationally.

**Figure 1: PAC**

**Figure 2: unloading of a ship carrying clinker**

**Study materials:** The study focused on workers employed by the company that operates the port**.**

**Data source:**

- Clinker worker schedule list,
- Files on workers assigned to clinker production;
- Systematic visit reports;
- Register of systematic occupational health visits;
- Register of workers who have undergone spirometry;
- Register of workers who have undergone chest X-rays.

**Collection medium:**

- An individual survey form;
- A spirometer;
- Chest X-ray images.

**Method**:

**Type and duration of study**:

This was a descriptive cross-sectional study lasting 12 months, conducted from 1 November 2022 to 31 October 2023.

**Target population:**

The target population consisted of all workers at the autonomous port of Conakry.

**Study population:**

The study included all workers employed in the clinker industry with at least one year of service.

**Inclusion criteria**:

All workers who had been working in the clinker plant for at least one year at the time of the survey and who gave their consent were included in this study.

**Exclusion criteria:**

All workers employed in the clinker plant who did not agree to participate in the study and for whom additional tests (chest X-ray, spirometry) were not performed were excluded.

**Sampling:**

We carried out systematic sampling (census of all cases meeting our criteria).

**Collection technique and procedure:**

- Through the land operations department of the port company that operates the port, we were able to obtain a list of all workers assigned to clinker production.
- During the systematic visit by the national occupational health service, we classified the files of workers assigned to clinker production;
- We then interviewed and physically examined the workers before performing digital chest X-rays and spirometry to check for respiratory disorders. The X-rays were read by a radiologist and the spirometry was performed by a pulmonologist.
- Patients with respiratory disorders undergo respiratory function tests when they return from leave to see if there is any improvement in FEV1.

**Ethical and professional** considerations:

We obtained verbal authorisation from the port authority, the national occupational health service and the company that operates the port. We obtained verbal informed consent from the workers and the information about the workers remained confidential. Anonymity was respected. Feedback on the validated recommendations will be provided to the company and the SNMT.

**RESULTS**

The company that operates the port of Conakry has **1,019** workers, of whom **209** (our study population) work on the clinker rotation, representing **20.5%.** The average age of workers was 40, with extremes of **20** and 72. In our study, timekeepers were the most represented, followed by crane operators, with **36.36**% and **26.80%** respectively**.**

**Table I: Distribution of workers according to comorbidities**

| **Comorbidities** | **N** | |
|---|---|---|
| Hypertension | 1 | 7.66 |
| COPD | 4 | 1.91 |
| Diabetes | 1 | 0.48 |
| Asthma | 1 | 0.48 |
| Chronic bronchitis | 1 | 0.48 |
| Pulmonary TB | 2 | 0.96 |

**Table II: Distribution of workers according to number of years of exposure**

| **Years of exposure** | **N** | **%** |
|---|---|---|
| 1 - <6 | 54 | 2 |
| 6 - <11 | 33 | 15.79 |
| 11 - <16 | 91 | 43.54 |
| 16 - <21 | 28 | 13.40 |
| 21 - < | 3 | 1.44 |
| **TOTAL** | **209** | **100.00** |

Average exposure time: **10.47 ± 5.16**; extreme **[1-25]**

**TableI : Distribution of workers according to functional signs**

| **Functional signs** | **N** | |
|---|---|---|
| Dry cough | 80 | 3 |
| Productive cough | 75 | 36 |
| Shortness of breath | 22 | 10.5 |
| Chest pain | 0 | 1.4 |

| | | |
|---|---|---|
| Melanoptysis | 29 | 14 |
| **Total** | **209** | **100** |

**Table IV: Distribution of workers according to chest X-ray results**

| **Radiological image** | **N** | **%** |
|---|---|---|
| Normal | 188 | 89.95 |
| p (opacity with a diameter of less than 1.5 mm) | 8 | 3.8 |
| m (diameter between 1.5 mm and 3 mm) | 5 | 2 |
| n (diameter between 3 mm and 10 mm) | 3 | 1.44 |
| Pleura | 2 | 0.96 |
| Other | 3 | 1.44 |
| **Total** | **209** | **100.00** |

*Other: basal hyperclarity, cardiomegaly and flattened domes.*

**Table V: Distribution of workers according to spirometry results**

| **conclusion of spirometry** | **N** | **%** |
|---|---|---|
| **Normal** | 124 | 59.3 |
| **restrictive syndrome** | 74 | 3 |
| **Obstructive syndrome** | 1 | 5.2 |
| **TOTAL** | 209 | 10 |

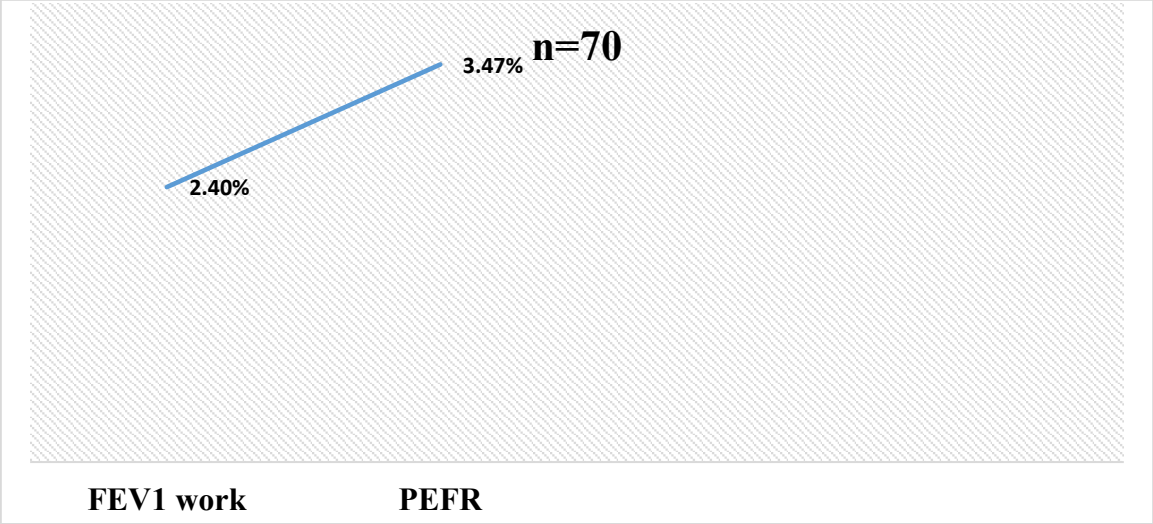


**Figure 3: Comparison of FEV1 during work and FEV1 upon return from leave**

**TableII : link between TV, duration of exposure, pulmonary Rx, dyspnoea and crackles**

Subjects studied

| Characteristics | TV | | Without TV | | p-value |
|---|---|---|---|---|---|
| | n | % | n | % | |
| Duration of exposure | 85 | 40.67 | 124 | 59.33 | 0.059 |
| Pulmonary Rx | 21 | 10.05 | 188 | 89.95 | 1.000 |
| Dyspnoea | 22 | 10.52 | 187 | 89.48 | 0.0005 |
| Rales | 12 | 5.74 | 197 | 94.26 | 0.0042 |

## DISCUSSION

➢ **Limitations of our study:**

We conducted a descriptive cross-sectional study with a sample size of 209 workers in order to describe the respiratory function profile of workers exposed to clinker dust in the autonomous port of Conakry.

Our limitations included the lack of chest CT scans, the lack of dust level measurements and the absence of plethysmography. Legal medical aspects were not addressed in this study.

➢ **Distribution of workers by age:**

According to the results of our study, we found an average age of 40, with extremes of 20 and 72. Port work requires energy, which explains the average age in our study; moreover, this is the age of peak physical activity.

The results of our study are very similar to those of Morocco (**El Ghazi Az-Eddine et al**), where the average age of workers was 32 **[2]**, while in France (**Gonzalez M et al)**, the average age was 57 [**10**].

➢ **Distribution of workers according to comorbidities:**

- **High blood pressure** was the most common comorbidity, followed by COPD, with 7.66% and 1.91% respectively.
- **With regard to smoking**, 14% of workers were smokers. Among smokers, we noted that 93% smoked less than 10 cigarettes per day. In our society, smoking is perceived as delinquent behaviour, which is why some people are reluctant to answer this question.

➢ **With regard to the duration of exposure** to clinker dust: In our study, we found that the average duration of exposure to the risk was **10 years**, with a peak frequency between **11 and 15 years**.

The average duration of exposure in our study differs from that found in many other studies.

In Morocco, **El Ghazi Az-Eddine et al.** found an average duration of 13 years, while in France, **Gonzalez M et al.** reported an average duration of 13 to 15 years [**2**] [**10**].

➢ **Distribution of workers according to the presence of functional signs:**

Cough was the main symptom (dry in 38% of cases and productive in 36%), followed by melanoptysis (14%). These are the first symptoms encountered during exposure to dust. This result differs from that in **Morocco,** where **Amal Moustarhfir** et **al.** found in **2016** that the main symptom was dyspnoea [1**]**. This could be explained by the fact that the Moroccan study focused on retired workers who had been exposed for a long time.

➢ **Distribution of workers according to physical signs:**

Physical signs were poor and auscultation was normal in 86.6% of cases. Among the pathological sounds, we found 5.74% crackles, 4.31% rhonchi and 2.34% wheezing. Our study is similar to that conducted by the Moroccans.

➢ **Distribution of workers according to radiological lesions:**

Frontal chest X-rays were contributory in only a few cases. However, in our study, we found 3.82% of p lesions (opacity with a diameter of less than 1.5 mm), 2.39% of m lesions (diameter between 1.5 mm and 3 mm) and 1.44% of n lesions (diameter between 3 mm and 10 mm).

Our results differ from those of **Amal Moustarhfir** et al, who reported 15% of **p** lesions and 27% of **n** lesions in **2016** [**1**]. This proves that radiological screening is an essential part of the monitoring and early detection of silicosis in workers exposed to Portland clinker, which is a significant source of exposure to crystalline silica dust.

➢ **Distribution of workers according to spirometry results**:

Respiratory function testing enabled us to detect suspected restriction in 35.40% of cases and obstruction in 5.26% of cases.

The decline in respiratory function parameters in our study during the first consultation of some workers shows that exposure to clinker dust causes long-term respiratory dysfunction. However, we have no evidence that workers' exposure to clinker dust is the cause of this restriction.

In our study, we found that nearly half (40.66%) of workers had mild ventilatory disorders during their first visit.

Among miners in Jerrada (**Essadki Belkhir)** examined at the 20 August Hospital in Casablanca (1970), the percentage of

severe ventilatory disorders (significant reduction in FEV1 of more than 50%) was around 14% [**11**].

The absence of severe respiratory disorders in our study can be explained by the average duration of exposure and the average age of the workers.

For the different types of disorders encountered, spirometry data found that 35.40% of workers had a restrictive ventilatory disorder, compared with 5.26% with obstructive disorders. The high number of restrictive disorders in our study can be explained in part by the obesity of some workers.

Cerevents states that: "***There is no typical respiratory profile in silicosis***."

In a study in Hong Kong (2005), **Leung** et **al** [**12**] found a predominance of TVO in 1,576 silicosis patients.

- **Comparison of average FEV1 during work and upon return from leave:**

We noted a 1% improvement in FEV1 on return from leave among workers with TVO, so we can say that the work subtraction test is positive.

- **Link between decreased respiratory function, duration of exposure, radiological image, dyspnoea and crackles:**

According to the results of our study, there appears to be a link between decreased respiratory function, dyspnoea and crackles, with significant p-values of **0.0005** and **0.0042,** respectively**.** A case-control study between exposed and unexposed individuals would be better suited to establish a link between exposure to clinker dust and decreased respiratory function.

## CONCLUSION

During our study, the majority of workers were asymptomatic and chest X-rays were only contributory in a few cases.

We noted in this study that respiratory protective masks were not worn, exposing workers to an increased risk of dust inhalation.

The spirometry results allowed us to detect obstructive and restrictive ventilatory disorders in workers exposed to clinker dust. Therefore, to protect workers, technical and medical preventive measures and monitoring are required.

We also noted an improvement in FEV1 during the subtraction test at work.

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