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Mini Review

Occupational Silicosis in Portugal: State of the Art and Gaps in Surveillance and Prevention

Renato Matos Barbosa*, Mafalda Bica Tavares, João Coutinho de Sousa, Amanda Dias, Rita Gil Duarte, Ana Beatriz Oliveira, Miguel Magalhães, Ana Catarina Carvoeiro, Filipe Araújo, Nuno Augusto Saldanha, Ana Sofia Duarte and Sara Alves Matos

Department of Medicine, Unidade Local de Saúde de Santo António (ULSSA), Portugal

***Corresponding author:** Renato Matos Barbosa, Department of Medicine, Unidade Local de Saúde de Santo António (ULSSA), Portugal
CIÊNCIA ID: F311-DD9D-D992 ORCID ID: 0000-0002-3893-8307

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Abstract

Silicosis is a chronic, incurable occupational lung disease caused by inhalation of crystalline silica dust, leading to inflammation, fibrosis, and nodular scarring in the lungs. This exposure occurs in occupational activities such as mining, rock drilling, sandblasting, the ceramic industry, glass manufacturing, and stone cutting. Modern industrial practices, including sandblasting denim jeans and the production of engineered stone countertops, have contributed to the return of silicosis cases worldwide.
The extraction of granite in quarries plays a key economic role in Penafiel and Marco de Canaveses in the Tâmega subregion of Northern Portugal. Penafiel has higher silicosis notification and prevalence rates than Northern Portugal. Because of that, local Public Health services started a screening program that targets stone quarry workers, as they have an increased risk to develop the disease due to exposure to silica and therefore Tuberculosis.
This review highlights the continuing need for regulation and effective strategies to minimize exposure and adverse effects of silica in the occupational context.

Keywords: Occupational Health; Silicosis; Workers

Introduction

Silicosis is a chronic lung disease resulting from the inhalation of fine silica particles over long periods of time [1], which leads to ongoing inflammation with permanent fibrotic damage to the lungs [2]. It accounts for 90% of pneumoconiosis cases, representing a major public health concern and it is strongly related occupational exposure [2]. Silicosis is also often associated with the emergence of other conditions, including tuberculosis, malignancies, and autoimmune disorders [3].

Occupational exposure to silica occurs predominantly in mining, quarrying, stone cutting and carving, sand blasting, with foundry work, tunnel boring, and in the production of silica flour [4,5]. Currently, with the emergence of new industries, such as artificial stonework, jewelry polishing, and denim production (sandblasting jeans), new, more accelerated and severe forms of silicosis have arisen [6].
Therefore, silicosis can present with one of the following 3 disease patterns: acute (after a period of a few months), subacute/accelerated (heavier and shorter exposures, i.e., 2 to 5 years) and chronic (that develops after at least 10 years of exposure to silica dust) [5,6]. There is currently no known targeted treatment. Patients with advanced silicosis may be candidates for lung transplantation [7] and in acute silicosis, complete therapeutic lung lavage has been used to physically remove silica from the alveoli [5].

The first descriptions of this disease were reported by Hippocrates (460 BC – 370 BC), who documented a high prevalence of respiratory distress in miners. Later, Bernardo Ramazzini, known as the father of Occupational Medicine, established a link between workers in metal extraction mines and the onset of respiratory diseases in his treatise on occupational pathology [8].

Materials and Methods

This narrative mini review is based on a targeted, non-systematic search of of articles in the PubMed scientific database, using combinations of the terms “silicosis”, “exposure”, “occupational”, “silica”, ‘’workers’’ and reports from the Centers for Disease Control and Prevention. The search was last updated in 2026.

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Results

Back in 1995, the World Health Organization launched an initiative aimed at eliminating silicosis worldwide by 2030. Despite this effort, silicosis continues to pose a significant global health problem [9]. As of today, it is estimated that 49,5 million small-scale miners have exposure to high silica content in their workplace [10]. There is no good quality data regarding the prevalence of silicosis globally, but it is estimated that there are around 2·6 million prevalent cases according to the Global Burden of Disease [10].

There has been a marked global rise in new silicosis cases, increasing by 64.61% from 84,426 in 1990 to 138,971 in 2019, while the disease continued to account for a substantial burden in terms of disability-adjusted life years (DALYs) [11]. A recent increase in silicosis cases has been reported among younger workers involved in the fabrication of engineered stone, or quartz, countertops in California and in countries such as Australia, Israel, and Spain [12]. The first case of silicosis in Australia linked to artificial stone used in benchtop fabrication was reported in 2015, being that by 2022, a total of 579 cases had been documented nationwide [13]. Additionally, from 2019 to 2022, 52 cases of silicosis linked to engineered stone were identified in California [14].

Unfortunately, no specific prevalence or incidence data for silicosis in Portugal were identified in the available indexed medical literature and one 2006 portuguese article even confirmed there was no official data on silica exposure in Portugal, although silicosis is one of the most frequently reported work-related diseases [15]. The most recent global studies on silicosis (2024-2025) analyze data from 204 countries and territories through the Global Burden of Disease Study, but do not provide disaggregated data by individual country, including Portugal [11]. One study presented the Silicosis notification rate in the Northern Region of Portugal which was about 2.4 (per 100 000) in 2012, this being their latest data [16].

Expanding on this, in the Northern Region of Portugal, located in the Tâmega subregion there are the municipalities of Penafiel and Marco de Canaveses which present a large sector of activity in the mining industry, specifically in the exploitation of granite quarries. Therefore, a higher number of mine workers compared to the rest of the northern region and country. Along with other factors such as higher population density, lower elderly dependence ratio, and a smaller number of clinicians, this leads to higher silicosis notification and prevalence rates in this locality [16]. The Tâmega subregion is also the most deprived area in the Northern Portugal in domains such as income, employment, health and disability, education and skills, habitation and environment and access to goods and services [17].

The European Agency for Safety & Health at Work highlights the need to install and maintain dust extraction and air filtration systems to control exposure. It also stresses the use of tools with built-in dust extraction and the availability and proper use of suitable equipment, including personal protective equipment. According to Directive 89/391/EEC of the European Commission, fitness for work assessment and regular health surveillance should include periodic chest X-rays, symptom questionnaires, and lung function tests. The responsible health professional must explain the test results to the individual [18]. Current evidence does not adequately define how effective or how often these measures, especially chest radiography, should be used to screen workers exposed to high concentrations of respirable crystalline silica from artificial stone who are at risk of accelerated silicosis. Early reports in this population show that many workers present with normal chest X-rays despite having clear signs of silicosis on high resolution CT scans [9]. There is no systematic national surveillance of silicosis, no studies on adherence to personal protective equipment in the Portuguese context, and no data on the real-world effectiveness of preventive measures. Evidence on the actual effectiveness of these measures remains limited, especially in Portugal, and adherence among workers and employers is not well characterized.

In the epidemiological context of Tâmega, the local and regional Public Health Services implemented the Menos Tuberculose Pedreiras 2018–2020 project. This project consisted of annual screening for TB disease and TB infection in stone quarry workers in the subregion. According to the results of this project, the estimated prevalence of silicosis among workers is 25% [19]. Considering that around 2,400 stone industry workers are active in Penafiel and Marco de Canaveses, this suggests that approximately 600 active workers have silicosis [20].

In Penafiel and Marco de Canaveses there is an ongoing program called +Saúde whose objective is to reduce the burden of silicosis and tuberculosis in the working population of the stone industry in Penafiel and Marco de Canaveses, through an extensive screening program [20].

Discussion

Some high-priority areas for future research in silicosis have been pointed out in several papers, such as:

- Recent outbreaks of silicosis linked to artificial stone highlight gaps in control measures for silica exposure reinforcing the need for ongoing vigilance to detect and manage both emerging and established sources of silica exposure [9].
- A way to standardize the measured dust levels in the mines and other related workplaces, the duration of service and work experience in diverse mining settings, and varying dust-controlling efforts and systems from one mine to another so we can correlate years of service and the type and severity of lung disease [3].
- A more comprehensive analysis of the studied population is needed, as other people besides the workers may be affected by working and living near workplaces [3].
- Increase understanding of the impact of other general measures such as psychological support, vaccinations and exercise programmes following the diagnosis of a silica-associated disease [9].
- Improving the evidence base for managing established silicosis, including interventions such as lung transplantation, whole lung lavage and antifibrotic drugs pirfenidone and nintedanib [9].

Conclusion

Given these gaps, there is a need for further studies focused on barriers and facilitators to adherence to occupational silicosis prevention measures, the behavioral and structural factors that explain non-adherence, and the cost-effectiveness of prevention interventions. Additionally, we need more data focused on exposure characterization in active workers, including type of

task, material, control measures, and use of personal protective equipment, with possible linkage to health data when available. Lastly, it will be important to study the barriers and facilitators that influence adherence by workers and employers to silicosis prevention measures, and identifies proposals emerging from the field to improve their implementation.

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