



Editorial

New Etiological Agents of Silicosis



Silicosis is a disease whose incidence has been progressively decreasing in some high-income countries in the last century, however, new sources of exposure are changing that trend.¹ In the 1990s, a new artificial stone product composed of finely crushed rock mixed with pigments and synthetic resins began to be manufactured and marketed. This material is commonly called quartz agglomerate, although its composition can also contain other silica polymorphs. This silica agglomerate has been vastly replacing natural stones such as marble or granite for use as bathroom or kitchen countertops, due to its wide range of attractive colors and designs.

Early this century, new cases of silicosis started to be diagnosed in various parts of Spain. These cases were found in workers employed at large companies that manufactured silica agglomerates and at small companies specialized in cutting, carving and finishing stone and installing kitchen and bathroom countertops.

In 2001, some workers of a large quartz slabs factory were diagnosed with silicosis after a short period exposed to this type of stone.² In 2010, the first 3 cases of silicosis caused by this material were published.³

Soon after that, a limited number of cases were reported in various parts of Spain and in other countries (Israel and Italy) that also produced this material. A large cohort of patients was reported in 2014 in a province of Spain⁴ where silicosis was practically unknown before the appearance of this material.

The aggressiveness of silicosis caused by this type of artificial stone soon became apparent. It occurs mostly in young workers⁵ and despite a short exposure time and latency, radiological progression and decline in lung function were evident,⁶ with a rapid evolution to progressive massive fibrosis even after exposure cessation.⁷

Silica agglomerates have characteristics that differentiate them from natural stones and that could explain the level of aggressiveness of silicosis produced by this material.

First, these agglomerates are usually composed of more than 80% silica (mainly quartz and, to a lesser extent, cristobalite and other silica polymorphs such as tridymite), while the silica content of natural stone is usually lower. During the processes of polishing and cutting silica agglomerates, a cloud of dust with very small particles (less than 1 μm) and a high respirable fraction of silica are generated at levels much higher than those generated with natural stones; thus, the higher the proportion of crystalline silica in the raw material is, the higher the fraction of respirable crystalline silica.^{8,9}

Second, another difference between silica agglomerates and natural stone is that silica agglomerate contains between 8 and 20%

resins that are used as a binder, while natural stone does not contain any of them. These resins contain volatile organic compounds such as styrene, toluene, benzene, ethylbenzene and phthalic anhydride, some of which cause bronchial or pulmonary inflammation,¹⁰ and polycyclic aromatic hydrocarbons such as phenanthrene and fluorene¹¹ that induce oxidative stress and inflammation in human lung epithelial cells.

Finally, this material can contain between 1 and 8% of metallic elements, some of which are of natural origin from the rock itself and others that are added artificially to improve the material properties. A wide range of metals can be found in certain types of countertops (Cu, Cd, P, S, Ni, Co, Cr, Sn, Zr, Cl, Fe, Ca, Mg, K, Ca, Mg, Na, Ti, Pb and Al, among others), and the composition varies depending on the design.

In patients with this type of silicosis, metals such as aluminum have been detected in the initial fibrohistiocytic nodules and in the fully established silicotic nodules. This aluminum displays the same centrifugal distribution as silica, sometimes with a higher aluminum content than silica in the center of the nodule.¹¹ Aluminum can cause different phenotypes of interstitial lung disease and can activate the inflammasome, similarly to silica.¹²

Although the main factor for the aggressiveness of silicosis caused by this material is its high silica content, other compounds could contribute to its aggressiveness and atypical presentations of the disease, such as polycyclic aromatic hydrocarbons, volatile organic compounds and metallic elements. However, more research is needed to clarify any specific role of these compounds and elements.

The artificial stone (also called engineered stone) market is constantly expanding and has an expected annual growth of 5.7%.¹³ Although new kinds of artificial stone are continually being offered on the market with low levels of silica (usually between 5 and 15%) without resins (sintered stone), the largest market share of artificial stone is silica agglomerates. Cases of silicosis are markedly increasing in Spain, with the annual average of reports of occupational disease due to silicosis in the five-year period of 2015–2019 growing by 1223.2% compared to the five-year period of 1990–1994, with much of this growth being attributed to exposure to artificial stone.¹⁴

New applications of silica agglomerates are causing new outbreaks,¹⁵ and the use of this material is expanding to floors and wall coverings. This means that many construction workers in a broad economic sector will be exposed to the material, making it difficult to disseminate information about the risks of this material and adopt rigorous prevention measures during its handling.

The onset of radiological lesions in patients could appear years after they have stopped working with artificial stone. Therefore, it is essential to be aware of this disease and for medical professionals to obtain a complete labor history of the patient to consider a possible diagnosis of silicosis, even after short periods of exposure in the past to silica agglomerates.

Silicosis is a preventable disease, so all possible efforts should be made to implement occupational prevention measures and, on the other hand, manufacturers must look for safer materials for workers and thus to avoid the appearance of the disease.

Conflict of interest

The author declares to have no conflict of interest directly or indirectly related to the manuscript contents.

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