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Short Communication

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Short Communication

Prevention of the Occupational Silicosis Epidemic in Australia: What Do Those Who Assess Workplace Health Risk Think Should Be Done Now?

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Abstract

An Australian National Dust Disease Taskforce was established to address the re-emergence of occupational lung disease, in particular silicosis. Exposure to respirable crystalline silica (RCS) occurs in various industries in Australia. We asked occupational hygienists about their practical experiences and perspectives on RCS exposure and regulatory action. A total of 105 members of the Australian Institute of Occupational Hygienists completed an anonymous questionnaire, which addressed individual characteristics, experience, perceived level of employer awareness, effectiveness of current regulation, and recommendations for improvement, across three main industrial sectors. Based on professional experience, 71% were concerned about the potential for RCS over-exposure. Barriers to adequate exposure control included lack of management commitment and financial resources. The employment of specialist occupational hygiene inspectors was considered to be the most effective regulatory strategy. Given the large number of exposed workers in the construction industry, with only a moderate awareness, there is the potential for significant cost shifting of the burden of occupational lung disease from employers on to individuals

What's important about this paper

Respirable crystalline silica (RCS) remains an occupational health challenge. This study surveyed members of the Australian Institute of Occupational Hygiene about their experience with RCS exposure assessment and management. The study identified need for increased focus on measuring and controlling exposure, reporting of over-exposures, and increased enforcement to ensure compliance with the workplace exposure standard; motivating change in policy and practice in Australia.

and the public health system. A nationally consistent approach to RCS exposure control across all industrial sectors is now recommended, with an increased focus on measuring and controlling exposure.

Keywords: control; exposure; hygienist; occupational hygiene; regulation; respirable; silica; survey

Introduction

Occupational exposure to respirable crystalline silica (RCS) is a well-known cause of a variety of respiratory and non-respiratory diseases in many countries (IARC, 2012). A number of industries have been traditionally associated with RCS over-exposure and silicosis (Doney *et al.*, 2020). In more recent times, exposure to RCS from work with engineered stone, also known as artificial stone, has been linked to severe silicosis in relatively young workers (Leso *et al.*, 2019; Hua *et al.*, 2022). The emergence of accelerated silicosis amongst relatively young engineered stone workers in Australia was considered a public health crisis, and led to the formation of a National Dust Disease Taskforce in 2019 (Department of Health, 2021) and a tightening of the RCS Workplace Exposure Standard (WES) in Australia to 0.05 mg m^{-3}. When the Taskforce handed down its recommendations in 2021, it included specific regulatory and non-regulatory actions designed to have an immediate impact on improving worker health and safety (Department of Health, 2021). These included a national dust disease registry and a greater priority on work health and safety monitoring and compliance activities. The Australian Government's response acknowledged those recommendations and required a regulatory impact analysis to evaluate the costs and benefits of changes to regulations (Australian Government, 2022). It did not support commencing the processes required to implement a full ban on the importation of some or all engineered stone products if there was inadequate regulatory compliance or ineffective intervention by July 2024.

Occupational hygienists have first-hand experience of the management of RCS exposure in Australian workplaces, but there is a paucity of information on how effectively RCS exposure has been controlled in Australian workplaces. This is vital information to understand the potential effectiveness of any future regulatory or non-regulatory intervention. Here, we present the results of a specifically targeted survey of members of the Australian Institute of Occupational Hygienists (AIOH). Such surveys have been conducted in the past and contribute to the evidence base for future interventions (Xiang *et al.*, 2015; Gaskin *et al.*, 2021). The aim of this paper was to evaluate hygienist experience of the current management of RCS in Australian workplaces and to gain insight into potential areas for strategic improvement.

Methods

An anonymous survey addressing practical experiences and perspectives on RCS exposure and regulatory action was developed and piloted by the External Affairs Committee of AIOH. It was hosted on the *Mentimeter* engagement platform. The weblink was made available in the members-only-area of the AIOH website, making it open to all members nationally, without restriction. The online survey was open from 18 March to 14 April 2022, following the release of the Australian Government's report (Australian Government, 2022).

A total of 105 AIOH members completed the questionnaire (see Supplementary Data Appendix 1, available at *Annals of Work Exposures and Health* online), which addressed individual characteristics, experience, perceived level of employer awareness, effectiveness of current regulation, and recommendations for improvement, across three industrial sectors, grouped as mining and quarrying, construction and tunnelling, as well as engineered stone. The decision to limit the survey to these sectors was based on what was understood to be government priority.

The thematic analysis of free text responses utilized a simplified inductive approach where the free text data were assembled and iteratively reviewed by multiple authors to determine distinct themes. Responses to closed questions were analysed by descriptive statistics.

Results

A total of 105 participants completed the survey. This represents 20% of all AIOH members, if based on membership profiles, where experience with RCS was nominated. Most of the respondents were senior members: 76% of respondents had more than 11 years of experience in occupational hygiene, with 49% having experience in engineered stone, 65% having experience in construction and/or tunnelling, and 84% having experience in the mining and quarrying sector.

Occupational hygienist experience and perceptions on RCS exposure data collected

The collective experience of respondents represented at least 7645 samples of RCS exposures being collected and reported on in 2021 (Table 1).

Based on their RCS exposure monitoring experience, 71% of respondents were concerned about worker over-exposure (i.e. greater than the Australian WES of 0.05 mg m^{-3} as a 8-h TWA).

The survey explored whether best practice air monitoring was undertaken to assess RCS exposure across different industry sectors. Fig. 1 shows that mining and quarrying industries were the most likely to carry out appropriate personal monitoring. However, almost half (43%) of respondents indicated that personal monitoring was being undertaken sporadically, that is with no set frequency, in both construction and/or tunnelling and in the engineered stone industry.

The use of 'real-time' dust monitoring devices can be used to assist employers to understand the variation in exposure over time, for example when peak exposure to respirable dust occurs. The mining and quarrying industries were most likely to use this technology, but concerningly, 66% of respondents said that engineered stone workplaces either '*seldom*' or '*never*' used such technology.

Survey participants were asked about compliance with the RCS WES with the most common response being that '*some of the exposures exceeded the WES and there is potential for higher exposures*' (Fig. 2).

The highest levels of perceived employer awareness on the risks from RCS exposure were reported in the mining and quarrying industries, followed by the construction and/or tunnelling industries, and then lastly, in the engineered stone industry (Fig. 3).

Table 1. Respirable crystalline silica sampling experience in 2021.

No. of RCS samples/results collected and reported on in 2021	*N*	%
	105	100.0
More than 500 samples	7	6.6
101–500 samples	28	26.7
51–100 samples	20	19.0
11–50 samples	27	25.7
Less than 10 samples	23	21.9

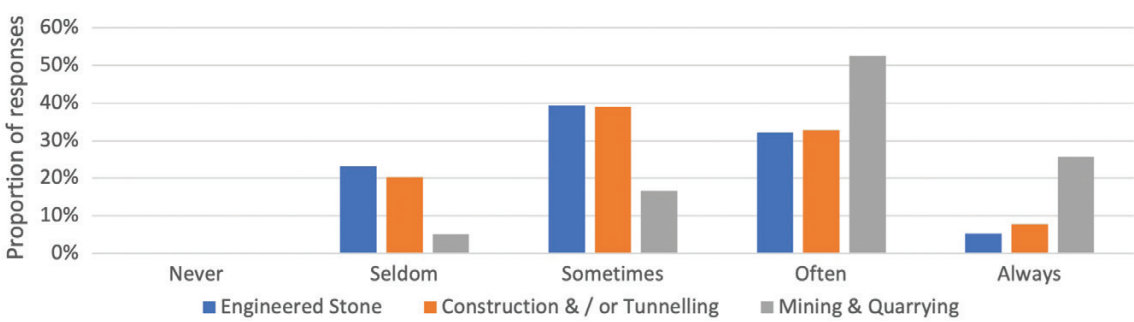

Figure 1. Reported occurrence of appropriate RCS exposure monitoring by industry group.

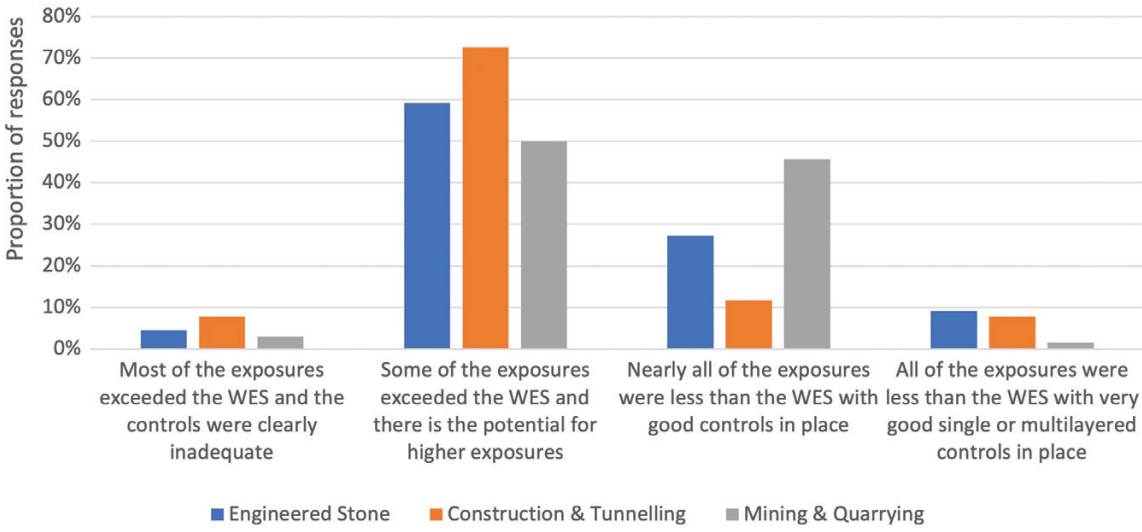

Figure 2. Reported level of compliance with the WES by industry group.

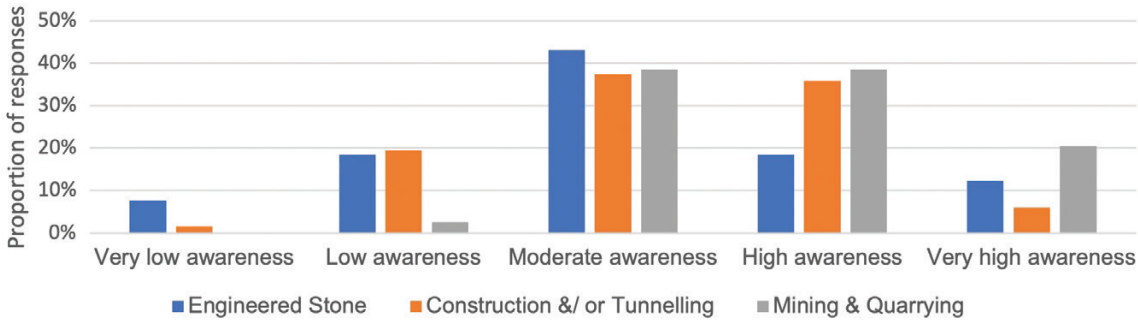

Figure 3. Reported level of employer awareness of the risks from exposure to RCS by industry group.

Occupational hygienist perceptions on employer and regulator interventions

Participants reported that behaviour change initiatives were 'sometimes' effective at reducing exposures to below legislative limits across different industry sectors, with the highest effectiveness reported in the mining and quarrying industries and lowest effectiveness in construction and tunnelling.

Perceptions about the effectiveness of compliance activity were explored (Fig. 4). The majority of survey participants selected '*somewhat effective*'. The results were similar for all jurisdictions across Australia, suggesting that the issue was not isolated to one particular jurisdiction.

Participants were asked to nominate the top three barriers for the prevention of silica-related diseases across different industries. The most common were (i) a lack of management commitment, (ii) a lack of financial resources for employers to adopt control measures, and (iii) low compliance with existing regulations. Other barriers included a lack of training, a lack of awareness, a lack of RCS-specific regulations, and a lack of competence of persons undertaking air monitoring and providing advice.

The top three most effective regulatory preventative strategies suggested by survey participants were (i) specialist inspectors, with detailed knowledge of RCS assessment and control, (ii) mandatory reporting of exposure exceedances, and (iii) awareness and education programs.

Free text themes

Participants were given the opportunity to provide free-text responses (see Supplementary Material, Appendices 1 and 2, available at *Annals of Work Exposures and Health* online).

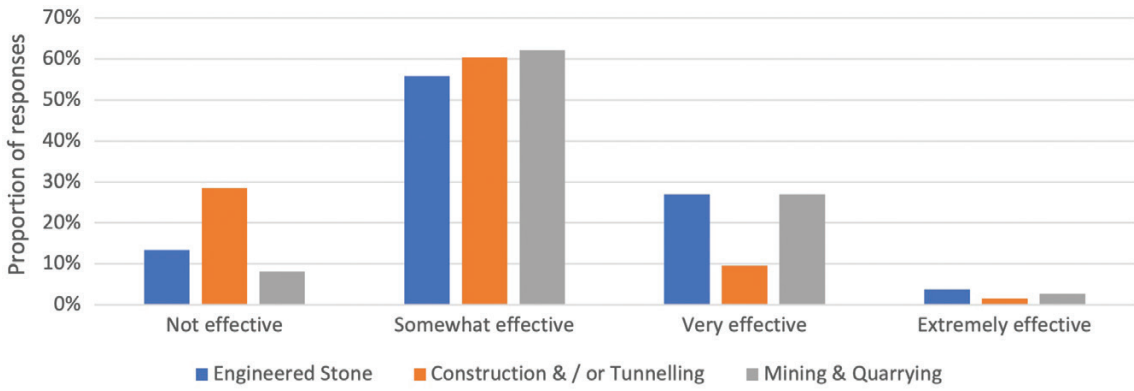

Figure 4. Reported effectiveness of compliance activities by the respective jurisdictional OHS regulator in reducing RCS exposures by industry group.

The following key themes emerged:

1. *A broader prevention strategy*: Participants noted poor compliance with control measures and air monitoring, and also with basic health monitoring. This showed the need for a national preventative focus bringing together occupational hygienists, medical professionals, and regulators.
2. *A federally coordinated response*: Participants identified that the federal government needed to be engaged and to have a clear plan of how silicosis would be prevented in Australia with a consistent approach to silica exposure control across all industrial sectors.
3. *Improved regulations*: More prescriptive regulations were needed, setting out a practical but pragmatic approach. Respondents noted the need to move the focus to control measures and control verification. Regulators should work with industry to include specific control strategies into the legislation. Participants noted the need for air monitoring to be specifically legislated for RCS and that the occupational hygienist should document the tasks carried out during air monitoring.
4. *A focus on compliance*: The strongest theme related to the need for increased enforcement by the inspectorate, aided by increased specialist resources undertaking more inspections across high-risk sectors. Increased compliance should be extended to control measures, air monitoring, and health monitoring activities. Respondents also highlighted that subcontractors should be a key area of focus for compliance inspections.
5. *Focus on the source of exposure*: Participants wanted more to be done to eliminate or reduce the amount of quartz in source products (Kumarasamy *et al.*, 2022) and more focus on the supplier's product stewardship obligations, acknowledging of the increased toxicity of freshly fractured crystalline silica.
6. *Respiratory disease monitoring*: The need for a national respiratory diseases database with mandatory reporting by the diagnosing doctor would enable tracking of silicosis trends in the population and early identification of new outbreaks. Health monitoring should track respiratory health over the lifetime as silicosis may only become evident after retirement (Graham *et al.*, 2001).
7. *Improved training and awareness*: Participants noted the need to improve the awareness of young workers through mandatory RCS awareness training for employees in industries with RCS exposure. Training needed to be more dynamic and engaging. It was recommended that the specific roles and activities that are at high risk be more widely publicized. More information was also needed including what 'good control looks like'.
8. *Technology*: Participants acknowledged the need to validate and encourage the use of direct reading devices for continuous monitoring and workplace compliance purposes. Participants also identified the need for financial assistance to improve the measurement of RCS.

The free text responses varied by industry sector, and the differences are shown in Supplementary Material, Appendix 2 (available at *Annals of Work Exposures and Health* online). However, common issues included employer prioritization of worker health, costs, lack of resources, and over-reliance on PPE.

Discussion

Occupational hygienists routinely work in and attend workplaces where RCS presents a significant risk

to health. Their insight on what is happening 'on the ground', the attitudes of management and the level of priority placed on the health of the workforce represents a valuable perspective. To our knowledge, this is the first survey of occupational hygienists relating to RCS experience and management perspectives. Some limitations of the survey include a relatively small sample size, the lack of unit-record level data (to preserve anonymity), self-reporting of RCS experience in the membership database and the simplified analysis of the free text responses.

However, the survey clearly highlights concern about potential over-exposure. With the exception of the mining and quarrying sector, the basic process of air monitoring is likely inadequate most of the time. Concerningly approximately 20% of respondents in the engineered stone and the construction and tunnelling industries reported that air monitoring is 'seldom' undertaken appropriately to assess exposure to RCS and where it is, compliance is suboptimal (e.g. exposures above the RCS exposure standard).

The level of awareness by employers on the risks of exposure to RCS was the highest in the mining and quarrying industry. This was not surprising, as the mining industry has had a long history with pneumoconiosis recently brought into the spotlight through re-emerging cases of coal workers pneumoconiosis (Zosky *et al.*, 2016). The mining sector is also dominated by large, multinational companies which employ occupational hygienists. By contrast, engineered stone bench top fabrication is typically carried out by small enterprises and they may have little or no understanding of the risks (Hoy *et al.*, 2021).

Construction is the sector with the largest number of RCS-exposed workers, estimated in excess of 300 000 (*Si et al.*, 2016). The extent of the problem may be greatest in this sector, due to the mobility of workers, sporadic air monitoring and only moderate awareness. In these circumstances, there is the potential for significant cost shifting of the burden of occupational lung disease from employers on to individuals and the public health system.

There was a disparity in the effectiveness of initiatives to reduce exposure to RCS across different industry sectors. Given that two of the top 'barriers' to improved exposure control are a lack of management commitment and a lack of financial resources, it is unlikely that behavioural change initiatives will be effective, consistent with the findings of Lunt *et al.* (2007) unless specifically required by regulation and enforcement.

There was also disparity across the industry sectors when considering air monitoring approaches, e.g. the use of real-time dust monitoring. There appears to be an inconsistent approach to protecting worker health across each industry.

Finally, many occupational hygienists reported that regulatory intervention on RCS was only '*somewhat effective*'. A greater focus on compliance with regulations was a strong theme. The barriers reported and the free-text comments suggest that further work in the area of compliance and enforcement is needed. Guidance on this approach was examined by Safe Work Australia (Safe Work Australia, 2013) finding that compliance inspections in small and large businesses trigger different actions and businesses are likely to respond differently. This conclusion suggests that a variation in the regulators approach to different businesses to achieve a desired level of effectiveness is needed. Further to this, occupational hygienists felt that when over-exposures do occur, reporting by the employer should be mandatory. At present, there appears to be few consequences for exceeding the WES.

Conclusions

The survey highlights the need to move away from the *status quo* towards a strategy with an increased focus on measuring and controlling exposure, reporting of over-exposures and increased enforcement to ensure compliance with the WES.

A nationally consistent approach to RCS exposure control across all industrial sectors is recommended. Occupational hygienist perspectives gathered here in the context of national regulatory and disease prevention strategies may be applicable in other countries.

Supplementary data

Supplementary data are available at *Annals of Work Exposures and Health* online.

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Conflict of interest

The authors declare that there is no conflict of interest. This work was undertaken as a volunteer activity through the Australian Institute of Occupational Hygienists Inc. The

authors' employers, as listed in the affiliations, had no role in the study design, implementation, or manuscript preparation.

Data availability

The data underlying this article will be shared on reasonable request to the corresponding author.

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