Worker Education Level is a Factor in Self-compliance with Dust-preventive Methods among Small-scale Agate Industrial Workers

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Abstract: Worker Education Level is a Factor in Self-compliance with Dust-preventive Methods among Small-scale Agate Industrial Workers: Bhagwan D. Aggarwal. Environmental Carcinogen Unit, National Institute of Occupational Health (Indian Council of Medical Research), India—Objectives: High incidences of silicosis are continuing to be reported among the agate workers of small-scale household agate processing units in the Kambhat region of Gujarat (India). The objective of this study was to investigate reasons behind the high prevalence of silicosis, and factors affecting the noncompliance with preventive methods among agate workers. Methods: The study was conducted using a questionnaire-based structured interview method among 82 agate workers in Kambhat to assess their awareness level about silicosis and preventive methods, existing morbidity, worker’s attitude toward health, and the prevalence of actual use of preventive methods to avoid silica exposure. Results: The majority of the workers (55%) were aware of silicosis and the harmful effects of silica dust exposure (72%) and knew about simple preventive methods to avoid silica dust exposure (80%), but only a minority of the workers (22%) were actually using the simple and available dust-preventive methods. Only 9% of the uneducated workers were using the preventive methods, while usage was higher among educated workers (28%), who had five or more years of schooling, and these workers had fewer health conditions or less morbidity. Gender and job duration had no effect on the usage of dust-preventive methods. Conclusions: The data suggest that noncompliance with use of dust-preventive methods could be the reason behind the higher prevalence of silicosis and health morbidity in agate workers, and that years of schooling plays a significant role in the increased usage and self-compliance with dust-preventive methods among agate workers.

Key words: Agate workers, Awareness, Dust-preventive methods, Education, Silicosis

Agate workers (locally known as “Akik” workers) in the Kambhat region of the Anand district of Gujarat state in India are at potential risk of exposure to high amount of silica dust due to grinding of agate stones in their occupation. Inhalation of silica dust (SiO₂) is known to induce silicosis among exposed workers. The relationship between long-term exposure to silica dust and development of silicosis is well-established1−4). Long-term exposure leads to development of silicosis and increased susceptibility to tuberculosis5) and to a higher risk of developing lung cancer6). Previous reports4, 7) and recent studies8, 9) continue to report high incidences of silicosis among agate workers. Agate workers are usually involved in various processes, including stone cutting, stone grinding, and polishing work on agate stones for ornamental and jewellery purposes10). The processes of stone cutting and grinding produce large amounts of silica dust11−13). Agate stone grinding is done on grinding wheels (emery) at a speed of 2,000−3,000 rpm, which generates a large amount of dust. The dust contains fine dust particles of 2−5 micron in size which when inhaled reach the alveoli of the lungs14). The dust sometimes contains more than 60% to 90% free silica15). A study revealed that the respirable dust concentration in household units is about 15-fold higher (2.35−2.74 mg/m³) than the permissible level (0.16 mg/m³), and the respirable dust was found to contain 60% free silica10−12). Interventions attempting to reduce silica exposure to reduce silicosis among agate workers have been performed by creating awareness about silicosis.
providing preventive devices, and by designing better dust-exhaust systems\(^\text{10}\). Still, most of the agate units have no exhaust systems, and most of the workers do not use any dust-preventive methods and remain at risk of significant silica-dust exposure\(^\text{8-10}\). This study was conducted using a questionnaire-based survey and structured interviews among agate workers to assess their awareness level about silicosis, awareness about preventive methods, and prevalence of actual use of preventive methods to avoid silica exposure and to investigate the possible role of awareness, gender, education, and job duration in the usage of preventive methods among agate workers.

**Subjects and Methods**

**Questionnaire-based awareness survey**

To examine awareness, attitudes and practices in agate workers, questionnaire-based structured interviews were conducted. The survey contained about 25 questions related to the worker’s age, level of education, income, job duration, self-reported health conditions and morbidities, knowledge about silicosis, knowledge about its causative factors, knowledge about simple and available dust-preventive methods, self-reported usage of preventive methods, and the reasons for not using the preventive methods. An interview-based survey was preferred because many workers were illiterate or poorly educated. The interviews were conducted among 82 agate workers out of about 215 agate workers in three villages, Metpur, Sakarpur, and Timba in the Khambhat region of Gujarat state in India (sample size about 38%). The trained research staff asked the questions in the local language after explaining the objectives and purpose of the study and obtaining the worker’s consent (written, or verbal in the case of illiterate worker) to participate in the interview. The interviews were conducted from June 2010 to July 2011. A typical interview took 20–30 minutes. No money or any type of incentive was offered to the participating agate workers for the interview to exclude possibility of false inclusion or to avoid any biasness in the answers. The questionnaire-based answers were coded and entered in an MS-Excel spreadsheet, analysed for the desired response and summarized in the tables and figures.

**Results**

**Profiles of the agate workers**

Table 1 shows a summary of the respondents’ backgrounds and profiles. There were slightly more female workers (57%) than male workers (43%). Being a household industry, more women might prefer to work in the agate industry. About 85% of workers were performing agate grinding. About half (52%) of the workers were 20–40 years old, 32% were 40–60 years old, and 16% were above 60 years old. The majority of the respondents (67%) had worked for 10 years or more in the agate industry, 28% had worked in the industry for five to nine years, and only 5% had worked in the industry for less than five years. Normally, the workers worked 6–8 hours daily. About 52% of the workers had an education beyond the primary level (more than five years of schooling), 21% had some primary level education (less than 5 years of school) and 28% were uneducated and did not attend school (Table 1). The majority of the workers had heard about silicosis, understood the harmful effects of dust exposure to a certain extent and knew about the simple and easily available preventive methods of wet grinding or use of a mask (covering of face with layers of cloths) to reduce silica dust exposure (Table 1).

The workers’ health conditions and morbidities were assessed by asking questions regarding any types of health problems they might have, such as cough, breathing problem and chest pain, and if they had visited a doctor or hospital; and if they answered yes, they were asked when, and whether their lungs were examined by X-rays or at least by stethoscope. Table 1 shows that 78% of the workers had health problems, such as cough, breathing, or chest pain, 71% had visited a hospital or doctors within the last year and 71% had been examined for lung condition either by X-ray or by stethoscope or by both. The data suggest the workers are aware of their health condition and are concerned about their health problems and willing to undergo medical treatments. Table 1 summarizes the survey results concerning understanding of the harmful effects of silica-dust exposure and awareness about silicosis. About 72% of the workers knew about the harmful effects of silica-dust exposure, 55% knew about silicosis, and 80% knew about simple and available preventive methods of either wet grinding or using masks (covering their face) to reduce silica dust exposure, but only 22% of the agate workers were actually using these dust-preventive methods. The most common cited reasons for not using a preventive method were feeling uncomfortable and inconvenient to use.

_Education of the workers increases self-compliance with usage of preventive methods and decreases adverse health effects_  

The agate workers were poorly educated: about half of them either did not have even the primary level (5 years of schooling) of education or were uneducated (Fig. 1 and Table 1). In the study, the relationship between their education level and their attitude toward the use of preventive methods and their health condition was analyzed. Analysis revealed that more
educated (with some school education) workers were more likely to use the dust-preventive methods than uneducated workers. There was a trend between the level of education and the usage of preventive methods: 28% of the workers with 5 years or more of schooling were using the preventive methods, 24% of the workers with less than five years of schooling were using preventive methods, and only 9% of the uneducated (no schooling) workers were using preventive methods (Fig. 1). There was also an inverse correlation between the workers having health problems and their years of schooling: 91% of the uneducated workers reported having health problems compared with 82% of the workers with some schooling, and 70% of the workers having five or more years of schooling. There was no such trend observed between the level of education and awareness level with regards to silicosis, knowledge about the harmful effects of dust exposure or knowledge about the simple and available preventive methods, though the workers having five or more years of schooling had slightly better awareness than the workers with lesser years of schooling, or no schooling. Most of the workers had visited doctors and had lung checkups within a year, irrespective of their education level. Still, the uneducated workers were slightly less likely to visit a doctor for a checkup compared with the workers with some education (Fig. 1). Fewer educated workers (five or more years of schooling) had health checkups—this might be due to having fewer health problems than lesser educated workers (less than five years of schooling) or the uneducated ones. The data reflects that there is a correlation between years of schooling and self-compliance with the usage of preventive methods. Workers having more years of schooling had fewer health problems, even though, the awareness level about silicosis disease, preventive methods and hazards of dust-exposure were similar in all three groups.

We analysed the data by gender of workers and job duration, and our data suggest that gender does not have a significant effect on self-compliance with dust-preventative methods (Table 1). It is likely that the workers having longer job durations have more awareness about the risk and are more prone to use dust-preventive methods. The higher awareness among workers with a job duration of ten years or more might be related to their longer duration in the...
The analysis of the relationship between occupation (job) duration and workers’ attitude toward the usage of preventive methods suggests no difference in the usage of preventive methods and job duration (Supplementary Table 1).

**Discussion**

Along with awareness about health and safety, education of the workers plays an important role in self-compliance to avoid exposure to occupational hazards in a nonregulated, or unorganized industry. During the investigation, efforts were made to have a
representative sample, and the analysis should reflect the behavior of the agate workers population. Data of this investigation suggest more self-compliance with preventive methods among higher educated workers (workers with more schooling). The health outcomes of the self-compliance is evident that worker with more schooling had fewer health problems compared with the workers with lesser schooling or no schooling. To the knowledge of the author, this is the first investigation of this type to highlight the importance of the worker level of education in self-compliance and adopting preventive methods in an unorganized and nonregulated work environment. In many cases, workers with higher awareness are unable to fully understand and comprehend the serious consequences to their health. From this analysis, it was observed that a higher awareness level does not necessarily translate into higher self-compliance with the usage of dust-preventive methods. In the construction industry, it was found that if workers can perceive an immediate problem, they would be more likely to use preventive devices. For example, workers who do not wear safety helmets or safety shoes may experience accidents quickly, but workers do not perceive the immediate health hazard of dust exposure, so they are less willing to wear personal respirator equipment to avoid dust exposure[10]. Most occupational hazardous exposures take years for the development of clinical symptoms, and many times, workers assume that all the awareness they have about the harmful effects of exposure may not be true for them and do not take hazardous exposures seriously. Hence, they are not willing to adopt even simple and easily available preventive methods. Similarly, consequences of dust exposure affecting health and safety are not usually immediately recognized; hence, awareness about the harmful effects of hazardous occupational exposures is important but may not lead to self-compliance or usage of preventive devices. Education plays a vital role in the development of knowledge leading to an understanding of the consequences of hazardous exposures. The poor educational backgrounds of agate workers might explain the failure of earlier interventions, an awareness campaign, providing masks, and installation of dust-reducing equipment, to reduce the silicosis incidences among the agate workers in the Khambhat region of Gujarat (India). In an unorganized sector, like the agate industry, self-compliance of workers with dust-preventive methods is the key to avoiding the hazardous exposure(s). This investigation suggests that the education level of workers is an important factor in understanding the harmful consequences of occupational exposure to silica and that therefore educated workers are more willing to use preventive methods.  

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