REVIEW ARTICLE

A Review of Occupational Safety and Health Problems Among Quarry Plant Workers

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ABSTRACT

Air pollution, with a range of health consequences is known to cause major public health issues especially to the respiratory system. Unfortunately, for those working in the cement industry, the respiratory system is vulnerable to injury following airborne or hematogenous exposure to toxicants. This study was undertaken to identify associated factors of occupational safety and health problems among quarry plant workers. Various Universities databases and other databases were searched with specific search such as occupational safety and health, quarry plant workers, cement, occupational exposure, respiratory symptoms. In the concrete sector, cement dust is the most visible and the pollution of fugitive and stack is mostly throughout two ways. The absorption of toxins into the human body and respiratory tract is a common occurrence where the air passage narrowness (nose, pharynx, glottis, bronchi are filtered). Previous research has shown that there is inadequate work safety procedures in quarry factories where the training and use of acceptable PPEs and hazards / safety measures training is grossly deficient. There is an urgent need to redesign processes in order to impose a barrier between danger and staff; to adopt safe working practices; to provide appropriate training for people, to provide training or information to reduce the risk of adverse health effects and/or harmful effects to people; and to implement personal protective equipment (PPE).

Keywords: Occupational safety and health, Quarry plant workers, Cement, Occupational exposure, Respiratory symptoms

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INTRODUCTION

Air pollution, with a range of health consequences, is known to cause considerable public health issues. Unfortunately, for those working in the cement industry, the respiratory system is vulnerable to injury following airborne or hematogenous exposure to toxicants (1). Air pollution is caused by air emissions by industrial and anthropogenic contaminants. Anthropogenic contaminants are toxins associated with human activities, including agricultural, household and industrial activities containing contaminating residues resulting from consumption and production activities (2). Air pollution has an impact on human wellbeing, security and the environment. Pollution of the air is estimated in different environmental problems to cause the largest damage to health and social welfare due to environmental factors in Asian countries (3).

Previous studies have shown that industrial dust can cause the increasing of morbidity, mortality or risk of getting respiratory diseases among the exposed population (4, 5). The number of cases reported at the Department of Occupational, Safety and Health (DOSH) Malaysia regarding to Occupational Lung Diseases was increasing from 86 cases in 2015 to 150 cases in 2016. Thus, occupational exposure to dust was detrimental to the workers. It was important to take account of the workers that were exposed to the dust as this can affect their health. In addition, the number of cement factories in Malaysia is also high as it has reached 18 plants in Malaysia. The issues of respiratory problems among industrial workers was overwhelming. This can be seen by the Social Security Organization (SOCSO) report (6) that reported an alarming number of cases that involved

respiratory symptoms was at 451 which consists of 325 cases in male and 126 cases in female workers. Since the number of cases in respiratory symptoms among quarry workers was increasing across the last five years, it was important to carry out this study in order to determine the occupational safety and health problems among quarry plant workers.

MATERIALS AND METHODS

Various Universities databases and other databases such as BioMed Central, Springer Online, PubMed, Taylor and Francis, Elsevier and BMJ were searched with specific search terminologies (7). The keywords searched were occupational safety and health, quarry plant workers, cement, occupational exposure, respiratory symptoms. The research screened covered a time span of between the years 1980 to 2020. This large span of time was taken to ensure all work in this field has been sufficiently taken into account (8). The inclusion criteria were occupational safety and health issues and problems among cement/ quarry plant workers concentrating on occupational exposure and respiratory symptoms. A total of 73 articles were initially screened. Firstly, the titles and abstracts were screened. Then the full articles were assessed for eligibility. Finally, the articles that matched the inclusion criteria were selected for this study. We excluded other types of industries (metal production and processing industry, chemical and petrochemical, food processing and waste treatment) that emit the same pollution and causes the health issues for their workers. We have only concentrated on the cement/ quarry industry.

RESULTS

Cement in Malaysia

Portland Cement is the most popular cement produced in Malaysia. In many cement factories worldwide, it was also commonly produced as Portland Cement is suitable for the production of general concrete. It is also the most common cement type (9). Masonry Cement is another cement also used for the construction industry (10, 11).

Dust problems and the relevance to cement industrial operations

The cement manufacturing process consists of several phases and components. These are of special interest:

1) On the exposure to hazards
2) Inter unit variability in exposure
3) Levels of dust emitted
4) Engineering mechanisms for dust control also differs in various units.

Therefore, we will look closely at activities to provide an understanding of the above viewpoints. It will also help us to understand the variation in disease trends between different employees from the same sector and improve strategy for each unit. The production process for cement can be divided into the following components (12-14)

Occupational Hazard

Occupational Respiratory Disease

Exposure at work can contribute to diseases in the airways. Nevertheless, it was important to identify these work-related illnesses early on for patients to achieve success. Szram et al (2012) reported that toxic respiratory irritants in the workplace can also lead to disease of the airways. Therefore, asthma is the most severe respiratory disease. Damage to the airways and bronchitis obliterating can occur after exposure to irritant. COPD was also linked to a person's job (15) .

Hazard related to Cement Dust

In the cement manufacturing industry, cement dust is the main contact and contaminants are mainly brief and processed in two cases. Fugitive dust material is any solid particles that are carried through a natural or human operation that is not emitted in a steady or stream-lined flow. Stack dust is a particulate matter from exhaust stacks through industry (16). The primary source of fugitive dust is its underlying composition, in which the technical mechanisms for the management of dust are negligible(17). Stack dusts are small and their adverse effects within the industry are less so because they are emitted into the external environment. For the contaminants in the mortar, it includes the metal polishing compounds of the external environment and the ecosystem, such as copper, cobalt, lead and chromium. The relation to cement dust is a synonym for transient dust. Cement dust is a transient, hazardous mineral substance (such as free crystalline silica containing more than 2 percent of total content of the class 1 carcinogens)(18, 19)

Pathogenesis of cement dust

The bronchial sound (hyper-reaction) and bronchial constriction of cement dust is increased by the irritant effect in the short term and the fundamental reaction in mucosal levels with high PH values is often shown on a molecular level (12, 20). Chronic exposure impairs the exchange of gasses leading to respiratory acidosis (12, 21). An example of the detrimental effects of cement dust is shown in Figure 1 (22).

Factors affecting pathogenesis

The pathogenesis associated with cement dust has four important factors. They include (12)

a. exposure
b. the routes of exposure
c. Limits of exposure and dose response effect
d. Variability

Exposures are the concentration or sum of a particular agent attained in a specific frequency for a defined term

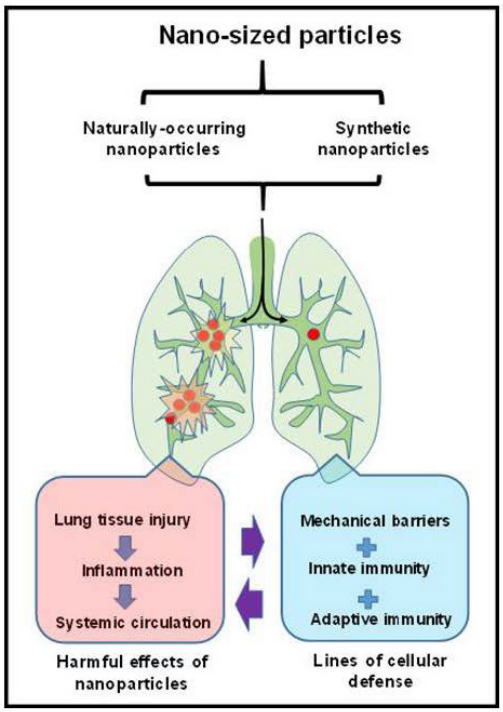

Figure 1 : The detrimental effects of naturally occurring and synthetic nano-sized particles, and lines of defence mechanisms in pulmonary system (22)

to a target organism, mechanism or subpopulation. Access evaluation involves assessing access to the agent (and its derivatives) to an organism, device or subpopulation(18, 19).

Inhalation is the main route through the nasal or oral cavity to penetrate cement material. The aerodynamic diameter of the projectile, the air circulation around the body and the breathing rate are important. Based on the different physiological and particle-related factors, the inhaled pieces will be retained or exhaled again. Five deposition processes include sedimentation, inertial impaction, diffusion, ingestion and electrostatic deposition (significant only in extremely small substances <.5 mm). The two important mechanisms are sedimentation and impaction. Skin and mucosal exposure are the most normal way to be ingested by dermal and mucosal into systemic circulation before enter the lungs due to the chemical properties of the cement (caustic). Wet cement [as the worker's skin is combined of sweat or water] is quickly absorbed. Secondary effects are also the central skin reactions. Conjunctival inflammation is mostly caused by a lack of sufficient eye protection and conjunctivitis and ulceration at practice. Poor hygiene makes food, drink or smoke taken in polluted or filthy areas of work, often inhalated particles are ingested and taken in, but are not taken into account for monitoring and measuring purposes with inhalation. (12, 18, 23).

DISCUSSION

Lung health study on cement-industrial workers

Systemic impact of Cement Dust

Previous researches have examined the occupational morbidities of cement workers in detail. The described adverse health effects were primarily respiratory followed by skin, hearing loss, gastrointestinal, eye, mouth and injury. The irritation and inflammatory pulmonary conditions such as rhinitis, laryngitis, tracheitis, bronchitis, pneumonitis are part of possible respiratory diseases. Allergic reactions cause workplace asthma and extrinsic alveolitis. Pneumoconiosis diseases are interstitial and fibrotic lung diseases which have an significant but more unusual silicosis, as is the deposition of dust in the lungs and the tissue response to its presence. Weaknesses in ventilatory findings on the Spirometer and directly EMG demonstrate cement dust association with breathing disability [intercostal muscles]. [electromyogram] (19, 24, 25). The most controversial issue is whether only asthma caused by immunology should be classified as occupational asthma, or whether asthma caused by exposure to irritants at work or exacerbating pre-existing asthma by irritants at the workplace should also be taken into account in the definition. The same happens as COPD. Nonetheless, it is the researcher's choice to use a broader or narrower approach, although the American Thoracic Society suggests a more broad approach to both. Therefore, any recent case of COPD / Asthma after work and its resulting exacerbations are recognized as jobs unless there is clear evidence that it happens from different sources or other stimuli.(26, 27). Wet cement from Portland is caustic, abrasive and moisturizing, but dry cement is less hazardous. It contains trace amounts of the dermal toxin hexavalent chromium[Cr(VI)]. Blisters, dead or bruised tissue, cuts or disfigurement, a non - allergic type of dermatitis and an allergic (allergic contact dermatitis) form of dermatitis (ACD) may be caused by OPC caustic burns and bursts. (12). A single exposure to chromium or repeated exposures may induce sensitization. (12, 28).

Occupational Exposure to Dust

There have been many forms of occupational health issues surrounding the production of cement. These health problems can also lead to death if the workers in cement manufacturing have not taken control measures. The result of cement manufacturing where the inhalation of smoke, fumes and gasses can cause illnesses in the workplace. This was due to inhalation, swallowing and immediate skin contact (29). The diameter of cement particles usually results in workplace lung diseases(30). The main path is through the respiratory and gastrointestinal tracts for the cement

particles to enter the human body. Workers who are exposed to small particles in cement processing tend to have restrictive lung disease, where the FVC and FEV rates are smaller. The cement group generally had respiratory tract problems as a result of airborne dust inhalation (31).

Prevalence of Respiratory Illness in Various Studies

Table I shows a number of cross-sectional studies have demonstrated an increased prevalence of respiratory symptoms and/or a reduction in lung function measures in cement production workers compared with those of controls (32). Table II summarizes the respiratory morbidity pattern in various important research across the globe in developing nations. It reflects the wide variation in the prevalence's across regions conveying the need for context and region-specific research (12, 33-40).

Table I : Overview of selected cross-sectional studies

Country	Exposed Workers N	Blue-collar worker controls	Adjustments for age and smoking	Outcome variables	Conclusion S/LFT
Egypt	223	x	x	S*	+***
Yugoslavia	847			S	+
Yugoslavia	290			LFT**	+
Denmark	301	x	x	LFT	—
Libya	110		x	LFT	+
USA	2736	x	x	S/LFT	—/—
Denmark**	546	x	x	H****	—
Taiwan	591		x	S/LFT	+/+
Jordan	348			S/LFT	+/—
Mexico§**	425			S	+
Malaysia	62		x	S	+
UAE#**	67		x	S/LFT	+/+
Saudi Arabia	150	x	x	S	+
Tanzania	126	x	x	LFT	+
Tanzania	120	x	x	S	+
Iran	80			LFT	+

S/LFT = *Symptoms; **lung function test (spirometry); ***+, higher prevalence of symptoms or dynamic lung volumes in quarry workers; —, no increase in symptom prevalence or difference in dynamic lung volume in quarry workers, f Inclusion of former workers.

**** Hospitalization study.

§ Use of a exposure weighting system.

United Arab Emirates

Table 2: Prevalence of Respiratory Illness In Various Studies

Safety Measures

In order to control these medical risks, especially with respect to exposure to cement dust, concerted safety measures are required to limit exposure to cement dust in the quarry industry, avoiding adverse health effects. The measures cover the redesigning of barriers to risk between workers; adopting standard operating or healthy working practices; supplying people with appropriate guidance, advice or knowledge to reduce the potential for harm and /or harmful health effects; and ensuring use of personal protective equipment; such as gloves, glasses, aprons, safety equipment (PPE). PPEs are generally the last line of defence and are typically used together with one or more other control measures(41, 42). The implications of not following these guidelines can be catastrophic, as managing these risks is crucial to reducing the risk of injury and disease for staff (41).

CONCLUSION

This study has shown that respiratory problems are associated with exposure to cement dust. Exposure to high concentration of cement dust in the cement manufacturing facility is associated with the decrease in the lung function of the workers. The exposure of dust also found to be responsible for the increased prevalence of respiratory symptoms towards of the workers. The effect from the dust exposure caused shortness of breath to the workers in their manufacturing workstations. Enforcement in using Personal Protective Equipment (PPE) also should be done in order to reduce the exposure of dust among the workers. Strict implementation of the Respiratory Protection Program is highly suggested in cement industries. Previous studies have shown that the quarry factories lack adequate occupational safety requirements, with major inadequacies in training in industrial hazards and safety measures as well as in the implementation of reasonable PPEs. Training of occupational risks and safety measures and the use of appropriate PPEs are grossly deficient and should be improved.

Table II : Prevalence of Respiratory Illness In Various Studies

PREVALENCE OF RESPIRATORY ILLNESS IN VARIOUS STUDIES [Among the unexposed is given in brackets] Figures in %								
AUTHORS WITH YEAR & REFERENCE	**Zeleke et al 2011**	**Negha b et al 2007**	**Meo SA 2003**	**Hossini CHL et al 2002**	**AL Neaimi et al 2001**	**Abu Dhaise BA et al 1997**	**Mengesha et al 1998**	**Saric M et al 1982**
REGIONS	Ethiopia	Iran	Pakistan	Morroco	UAE	Jordan	Ethiopia	Yugoslavia
OVERALL				65[34.2]				
SNEEZING	85							
RHINITIS	45			49.3[26]				
SINUSITIS					27 [11]			
SHORTNESS OF BREATH	47				8[4]			
COUGH		31.8 [20]		56.1 [19.2]	30 [10]	18.7	24.7[9]	
PHLEGM/ SPUTUM		26.1 [15]		52.5 [24.6]	25[5]			
DYSPNOEA		17[5]			21[5]	17.5		
BRONCHITIS			2[By X Ray]	29.3 [9.6]	13[4]		21.8 [9.5]	
WHEEZE/ ASTHMA		28.4 [5]		14.3 [6.8]	8[3]	15.8	24.2 [8.5]	
VENTILATORY FUNCTION Abnormality				32.5 [13.7]	36[10]	No significant change		0.08[FEV1]0.16 [FVC1] 0.268[M EF50]- Annual fall in L
EMPHYSEMA[By CXR]				15.9				
ILD [By CXR]			12	11.5				

CXR - chest x-ray
ILD - Interstitial lung disease
FEV1 - forced expiratory volume in one second
FVC - forced vital capacity
MEF50 - Maximal Expiratory Flow at 50% of Vital Flow Capacity

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