PNEUMOCONIOSES AND SILICOSIS: RISING ISSUES IN DEVELOPING COUNTRIES

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ABSTRACT

Pneumoconioses is a term used for the diseases associated with inhalation of mineral dusts. Certain types of pneumoconioses included in the definition are silicosis, asbestosis, coal worker's pneumoconiosis (CWP), stannosis, and baritosis. Among these, silicosis, CWP, and asbestos-related diseases are the most well-known occupational diseases occur due to widespread exposures to silica, coal, asbestos, and various mineral dust in mining, quarrying, construction, and other manufacturing processes. Pneumoconioses has long latency periods and can often go underdiagnosed and unreported. Their associated illnesses such as chronic obstructive pulmonary disease, silico-tuberculosis, silica- and asbestos-related cancers often cause permanent disability or premature death.

In many industrialized countries, the intention in improving the occupational health of workers as well as environmental health of the community has been seriously managed. On the other hand, the issues of occupational respiratory diseases, particularly Pneumoconioses in other countries have been neglected. This literature review use data collected from Google Scholar and PubMed with keywords including Pneumoconioses in Vietnam, silicosis in Vietnam, occupational lung diseases, developing countries to locate relevant research. After that, we use criteria selection including year of research published, keywords to narrow down the number of references used in the paper. Out of 65 papers resulted from the first round of selection, there were 30 papers selected. The result provides summary of current situation of Pneumoconioses and silicosis in certain growing nations including Vietnam with potential interventions suggested to improve the health and environment of destination countries.

I. INTRODUCTION

Pneumoconioses is a term used for the diseases associated with inhalation of mineral dusts. Pneumoconioses was first described as lung diseases associated with mineral dust exposure in 1866, then defined as the accumulation of dust in the lungs and the tissue response to its presence in 1971. Certain types of pneumoconioses included in the definition are silicosis, asbestosis, coal worker's pneumoconioses (CWP), stannosis, and baritosis. Among these, silicosis, CWP, and asbestos-related diseases are the most well-known occupational diseases occur due to widespread exposures to silica, coal, asbestos, and various mineral dust in mining, quarrying, construction, and other manufacturing processes. Pneumoconioses has long latency periods and can often go underdiagnosed and unreported. Their associated illnesses such as chronic obstructive pulmonary disease, silico-tuberculosis, silica- and asbestos-related cancers often cause permanent disability or premature death.

Asbestosis and silicosis, which share similar symptoms, development, high risk groups, and both terrible consequences in human health and quality of life, are the most

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common types of pneumoconioses all over the world. The distinct between these two outcomes are the role of smoking. While the appearance of asbestosis was opposed to be primarily fibre dose, size and type, and cigarette smoking habits, the development of silicosis is influenced by dose and type of silica, but apparently not by smoking. For that, silicosis is more unlikely to be underdiagnosed and forgotten.

In the limitation of this paper, the exposure to silica and silicosis among workers in developing countries are discussed. The first section of this paper reviews a brief summary of silica and silicosis, followed by current problems regarding to silica exposure in developing countries. In the third section, recent measure management plans applied in these nations are approached. Lastly, the paper concludes some effective management plans suggested as well as recommendations for hopefully intervene the unfortunate consequences.

II. THE INCREASE IN REPORTED CASES

While in industrialized countries, the decrease in pneumoconioses incidence and the severity of the disease resulted due to the reduction in number of workers at risk as well as limitation the duration and intensity of exposure in recent years, in other side of the world, however, things are observed to be completely different. In developing nations, the rapid expansion of such industries and hygienically poor working conditions put many workers at risk. In China, pneumoconioses make up more than 80% of all cases; in recent years, between 10,000 and 23,000 new cases have been registered annually. In India, about 10 million workers employed in mining, construction, and various industries are exposed to silica dusts; some studies show that silicosis prevalence rates are 54.6% among slate pencils workers and 35.2% among stone cutters, while the CWP prevalence rate is 18.8%. Studies in Latin American revealed a 37% prevalence rate of silicosis among miners and 50% among miners over the age of 50. Brazil estimates that 6.6 million of its workers are exposed to silica dusts.

Vietnam is one of populations producing and exporting the fine pure quality of coal toward many nations. In this country, pneumoconioses account for 75.7% of all compensated occupational diseases. A study which collected 234 chest x-rays results of mining workers addressed that there were 28.274 cases of occupational disease diagnosed, 74.2% (20,993 cases) of which was pneumoconiosis. The data was reported by the Department of Health Environmental Management in 2014. Epidemiology shows that between 30 and 50% of workers in primary industries and high-risk sectors may suffer from silicosis and other pneumoconioses.

Although the increase in occupational statistic does not imply the true increase in cases, but it may be caused by the improvement of health surveillance, recognition and compensation mechanisms, changes in work processes and organizations, workers' and employers' awareness of occupational diseases, broadening the definition of occupational diseases and manifestation of long-latency diseases, the given data still suggests the critical burden of pneumoconioses across less advanced world. Despite that pneumoconioses have posed crucial impacts on health and wellbeing of not just the subjected workers but also their loved ones, there are only few being done by

the related organizations and governments to prevent the strategy from happening.

III. DISCUSSION

1. Respirable crystalline silica exposure and silicosis

Silica or silicon dioxide is the most abundant mineral and occurs in crystalline and amorphous forms. The most common free crystalline forms of silica in workplaces are quartz, tridymite, and cristobalite. Quartz can occur naturally and at varying concentrations in rocks such as sandstone (67% silica) and granite (25-40% silica). Cristobalite and tridymite occur naturally in lava and are formed when quartz or amorphous silica is subjected to very high temperatures or in the manufacture of silica bricks used in industrial furnaces. Dusts composed of non-contaminated amorphous silica, with the exception of fibreglass, are not generally considered to be harmful to people. Calcined diatomaceous earth and other calcined amorphous silica containing crystalline silica are fibrogenic and more likely to affect human health.

Occupational exposure to respirable crystalline silica (aerodynamic diameter <10 µm), occurs in many industries and occupations, whenever substances or materials containing free crystalline silica such as rocks and stones are mechanically broken down to form dust or when those containing fine particles of silica are handled or disturbed. There is evidence that freshly crushed silica is the most toxic form of free crystalline silica. The cumulative dose of free crystalline silica and exposure duration is the most important factor in development of silicosis. Recent studies suggested no silicosis occurred when cumulative exposure was below 0.9 mg/m^3-years.

The industries which are known to contain highest risk of free crystalline silica exposure are construction, mining, and mineral processing, and in manufacturing sectors such as foundries, pottery, and glass. In construction, silica dust is produced during sandblasting, rock drilling, masonry work, jack hammering, and tunnelling. Mining, mineral processing, stone cutting, pottery, and glass manufacturing, foundry, agriculture, abrasive blasting operation, shipyards, and manufacture of silica also produce silica dust.

As the result of breathing respirable crystalline silica dust, the formation of scar tissue and reducing the lungs' ability to take in oxygen which is called silicosis. Since silicosis, effects lung function, it makes more susceptible to lung infections such as tuberculosis. Additionally, smoking causes lung damage and adds to the damage caused by inhaling silica dust.

Silicosis is classified as lung carcinogen by the International Agency for Research on Cancer (IARC) with three types including chronic or classic silicosis, accelerated silicosis, and acute silicosis. Chronic silicosis is the most common type, occurs after 15-20 years of moderate to low exposures to respirable crystalline silica. Accelerated silicosis can happen after 5-10 years of high exposures to respirable silica dust. Acute silicosis occurs after a few months up to 2 years following exposures to extremely high concentrations of respirable crystalline silica. There are also combined forms of silicosis with tuberculosis which is called Miners Phthisis.

Generally, the consequences of having silicosis are permanent morbidity and mortality of not just the workers themselves but anyone who are directly or indirectly

influenced by the deadly dust. The most important point is that there is no cure for the disease, but it is completely preventable.

2. Addressing problems that would have attributed to the increase incidence and severity of silicosis in less developed continents

Developing countries face many problems that can contribute to the rise of number and severity of silicosis including the recent burden of tuberculosis and HIV/AIDS, demographic changes, inefficient management plan in environmental and occupational health. Altogether, these socio-economical, environmental, and individual determinants attribute to the weight of silicosis in the worker's health and wellbeing as well as general society.

For the last century, developing countries have reached a magnetic increase in industrial areas due to cheap labour, less cost in productivity, and rich natural resources. For that, investments are put into developing such targeted industries. In consequence, the demand for labour has drawn not only domestic workforce but also migrants. The flow of immigration has led to certain changes in demographic characteristics in these relevant countries. Overcrowding population density is a crucial issue that may pose a significant burden in domestic environment including noise, water, and air pollution as well as hygiene issue which may result the widespread of contaminated diseases.

The occurrence of tuberculosis and HIV/AIDS remains a critical issue in the general population and it is even worse among vulnerable groups. HIV/AIDS and silicosis are mutually reinforcing epidemics that each dramatically increases the susceptibility of workers to tuberculosis as well as combines effect of silicosis and HIV infection. These risks do not merely interact to each other but multiply each other. Silica exposure particularly increases tuberculosis risk even without silicosis and the effects of silicosis and HIV infection on tuberculosis are multiplicative. Empirical data suggested major mortalities and morbidities result from the coexistence of silicosis, tuberculosis and HIV/AIDS in developing areas. For instance, in Anglo-Gold in 2002, 29% of its mining workers was 29% HIV positive and more than half of these had complications with tuberculosis and silicosis.

Moreover, the strategy of preserving and protecting the environment is insufficient [25]. Many studies suggested that gas emission and air pollution in developing countries were far worse than we imaged. As tuberculosis is spread out in the air and widely transmitted between healthy and sick-individuals, air pollutants would attribute to the widespread of the tuberculosis. Besides, in low- and middle-income countries, educational level as well as awareness of occupational exposure are likely to be under-considered among workers and their family. Certainly, the awareness of wearing protection uniform is low among workers.

Occupational health and safety management is underestimated and under-controlled including wearing appropriate protection uniform, exposure monitoring, and inefficient technologies. In most Southern Africa countries, there were insufficient technologies implemented that were crucial in raising the levels of dust in the miners such as pumping and winding engines, the large-scale usage of cheap dynamite, and the widespread application od machine drilling. In combination, these technologies increased the amount of dust in the mines as well as

created the dense concentrations of fine silica particles in confined spaces that so adversely affected the lungs of the workers. Moreover, the environmental factors also added to the deadly dust were intense working hours, tremendous fluctuations in temperature below and above ground, together with overcrowded and filthy barracks and poor nutrition.

The health and wellbeing of workers have not been a concentration of local governments and industries such as workers' compensation and medical insurance. For instance, in South Africa countries such as Botswana, Thamaga, there was about 40% of mineworkers had pneumoconioses and 6.8% among these had progressive massive fibrosis which was the most crippling form of silicosis, however, two-thirds had received no compensation, and 3% had received compensation in full. Generally, many studies revealed that half a million ex-workers in Southern Africa were suffering from compensable lung disease and 2.8 million workers had unpaid compensation.

Discrimination is another giant problem in developing countries especially in South Africa where compensation of workers differs on the grounds of race or skin colour. Not only black miners receive far less compensation than white miners due to related earnings, but they were in additional paid in lump sum while white miners received pensions.

3. Measure management approach

The nature of interventions to control silica varies from industry-to-industry and is dependent on the task or the process being used. In general, regulating occupational exposures to minerals and removal of symptomatic persons from the workplace are important measures to prevent or ameliorate mineral-induced lung disease. Also, studying dose-response effects following silica exposure have traditionally relied on simple cumulative exposure estimates, in which silica concentration and duration of exposure (in years) have been given the same weight is a significant approach to plan a monitoring scheme. Recent evidence has led to an approach of four nature of interventions including the substitution of silica sand, wet method, ventilation systems, and worker training and personal equipment.

The key to preventing silica exposure is to prevent or minimize inhalation of the dust. The ideal way to prevent silicosis is to remove or eliminate silica from the entire operation. For instance, in most abrasive blasting operations in construction and transportation sector including ship and bridge maintenance, substituting steel shot for silica sand, or high-pressure water for silica reduces silica exposure to zero.

In most industries, however, substitution is not an option, and engineering controls such as controlling the dust through wetting the drilled or ground surface may be the control of choice. Wetting down or misting surface to be cut or drilled is an old, reliable dust control technique. For example, attaching a hose to a drill or jackhammer will keep the rock or concrete moist and reduce dust to almost nothing. Numerous studies have given that using wet methods on cut-off saws in the construction industry would reduce respirable dust levels by 90%.

Local exhaust ventilation (LEV) is another method to control dust. This method was reported to be successfully used in the Vermont granite industry for the past 60 years. Unventilated grinders used to remove mortar between bricks produce high exposures, while simply attaching a vacuum

reduces emissions considerably. In particular, exposures in this operation were reduced from 20 mg of respirable silica dust per cubic centimetre of mortar removed to less than 0.2 mg/cc of mortar removed with the use of a ventilated grinder. Respirable crystalline silica levels were reduced by 90% using LEV on cut-off saws in the construction industry. In the mineral processing industry, the cleaning chamber reduces the amount of dust that escapes from the bags as they move from the loading station to the stacking station. It is a small ventilated chamber with brushes to clean the bags, and ventilation to collect the escaped product. With this method, the silica exposure of everyone in the workplace is reduced to almost zero.

Worker training and personal protective respirators is a control program in which the knowledge of hazard for both the people who design the work process and the workers themselves. With this intervention, it is very difficult to quantify the effect of training. As it is pointed out the main effect of training is to raise the worker's awareness of a hazard enough so that they will demand equipment controls. While the use of respirators is common to prevent silica exposure, it is far from ideal. Respirator programs on worksites are notoriously difficult to maintain. Respirators must fit snugly, and therefore preclude the growing of facial hair.

For most places, in construction, there are numerous dusts produced during activities such as demolition, cutting and sawing concrete, making concrete by mixing dry concrete with water, and abrasive blasting operations to scarify or smooth concrete, or remove paint to prepare a structure for painting. A combination of interventions such as silica substitute in abrasive blasting and wet cutting and sawing concrete may both be required in the construction sector.

IV. CONCLUSION

Pneumoconioses and silicosis are crucial issues in developing countries. They do not only attribute to the burden of recent diseases but also cause life lost and morbidity among workers in developing countries. Moreover, the cost for health expenditure due to these diseases are uncountable. Yet, few studies in respirable crystalline silica exposure and silicosis, as well as their impacts on worker's health and wellbeing are conducted in these nations. The effects of these diseases do not pose a dramatical pressure on human and environmental health alone but combine with other social economic and environmental determinants that altogether put a significant burden to the related countries in the concept of economics, environment, and individual and community health.

The four given interventions can be applied to other industries across developing continents individually or in combination. However, there are international regulation recommended to take responsibility for monitoring and management of the interventions. These international rules may be a recognized measurement to ensure the following countries would stand with their standards.

These problems do not only occur in developing nations but also influence on the wealthy countries because what happens on the one side of the world will put a certain impact on the other side of the world. For that, we do all share a common responsibility to our health, community, and world. If we can control the outbreak of these issues in developing countries, we do have a positive change in our world in present and future.

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