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Review Article

Prevalence of respiratory disease in the population of Queensland communities in proximity to coal mines and coal mining activities

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ABSTRACT

Air quality related to respiratory illness is examined in many settings, including populations that work or reside close to sources of pollution. Industry produced pollution from mining and metal manufacturing, natural environmental pollution as in the case of bushfires and large-scale dust storms are examples. We reviewed any available literature and data concerning the Queensland coal industry and its effect on respiratory health of miners, mining related workers and communities in proximity to coal mines. We searched various databases using keywords related to coal and respiratory diseases, using the five step criteria defined by Denyer and Tranfield. In the Queensland coal mining industry, the negative effect of mining on workers' respiratory health has been known for many years and has received increased attention in the last five years both nationally and internationally due to the resurgence in Coal Mine Dust Lung Diseases and specifically Coal Worker's Pneumoconiosis (CWP). A Queensland parliamentary review has prompted regulatory amendments for the permitted (occupational) exposure level (PEL; OEL) to coal dust and silica; amendments have also been enacted for better occupational respiratory health surveillance of Queensland coal miners, both surface and underground. Considering Queensland has a high proportion of Australian coal mines, the literature available on respiratory health in Queensland coal mines and surrounding communities is minimal. There is very limited research into, and possible underreporting of CMDLD amongst the coal mining workers in Queensland. Further studies are required to better understand air pollution and health effects in coal miners in Queensland.

Keywords: Coal mining, Occupational health, Environmental health Queensland, Air pollution

INTRODUCTION

There is limited information on whether living in close proximity to a coal mine or the resultant processes of the coal mining industry (e.g., rail and road transport corridors of coal to coastal ports for exportation, coal-fired power stations) affects the health of the residents of these communities. There have been numerous studies on the subject overseas and within Australia. It is a divided issue with some reports stating that living in close proximity to the coal industry has no significance on lung health for members of the general population as opposed to findings that close proximity to coal mines results in a range of illness and disease, amongst which lung diseases feature prominently.[1,2] In 2015, a Queensland coal miner was diagnosed with coal workers pneumoconiosis, this signalled an unexpected emergence of the disease after an absence of reported cases since 1984. As more cases started to be diagnosed, and upon investigation into the process of lung screening for this disease it was discovered that the disease may not have disappeared at all, cases of Black Lung were actually being incorrectly diagnosed as other types of lung diseases. This was due to lack of medical expertise in the field of occupational medicine and the related X-ray procedure and analysis techniques that were used for diagnosis (coal workers' pneumoconiosis select committee inquiry report).[3] In fact, it was reported in August 2016 by ABC that there were four probable cases and seven possible cases of black lung between 1995 and 2015 (McCutcheon).[4] This leads to question how many other misdiagnosed cases of Black Lung had slipped through the cracks over the years? In addition, the misconception that only underground coal miners were at risk of Black Lung disease was turned over by the discovery of the disease amongst above ground open-cut coal miners, therefore sectors of the mining industry to date had remained untested and unprepared for possible contraction of black lung.[5]

An update on the figures for the resource sector in Australia in 2017 by Geoscience Australia 2019 reported Australia as having a 4th of the world's coal reserves at 12.7%.[6] Australia's position in the global production and export of coal has implications that reach beyond the obvious local economic and environmental issues, the issue of miner health has recently made a resurgence into the headlines and law courts, and domestic studies into this area of concern have been increasing accordingly. However, a great deal of our current information comes from international studies on the subject in countries that have robust coal industries and accordingly there have been many international studies on the effects of coal mining (underground and open cut). Among the most notable is the Appalachian region of the USA and China, where coal mining has not only been a job for many but a way of life for generations. In 2008 a study was published that showed prevalence of chronic heart, lung and kidney diseases in coal mining communities and those in close geographical proximity to them, as well as coal mining activities (such as coal processing chemicals, uncovered coal trains). Hendryx et al calculated the increased risk for chronic obstructive pulmonary disease COPD as 64% and reported that the risk of hospitalization for COPD increased by 1 percent for every 1,462 tons of coal produced.[2] Australian studies of coal mining and coal mining activities within the state of New South Wales (NSW) mention issues relating to the situation such as environmental injustice issues in the Upper Hunter region as well as obstacles to health studies of mining effects.[7] The public health cost of sulphur dioxide emissions from coal power plants in New South Wales; and the high rates of hospital admissions for children in areas of coal seam gas development and coal mining in rural NSW compared to lower incidence/prevalence in the rural areas without this industry.[8,9]

As a juxtaposition to the lack of literature, Australia had a much earlier recognition of the dangers of coal dust on respiratory heath for coal miners, an acknowledgement that gained support in Australian industry and Government through the social and political arena of the second world war and directly after, rather than medical and scientific research. Miners and their families inherently knew that coal dust was to blame for chronic respiratory health issues, but at the time had little scientific proof. The political and social landscape of post war industry within Australia led the way for some medical professionals to then substantiate and support that coal dust did in fact cause coal workers' pneumoconiosis (CWP) or Black Lung. Silicosis however, had been long acknowledged as a legitimate occupational disease, already recognized and covered by the first NSW workers' compensation legislation in 1910.[10] Despite this early recognition of the health hazards from exposure to high levels of coal mine dust, resurgence of coal mine dust lung disease (CMDLD) came as a surprise to the public and study into why this re-emergence has occurred has uncovered possible reasons including complacency of health and safety regulators, increased production (increased dust), longer working days, thinner coal seams (producing more quartz dust) and inadequate monitoring and medical testing regulations.

QUEENSLAND RESPIRATORY HEALTH

The Australian bureau of statistics (ABS) reported through the National health survey of 2017-2018 the top 10 chronic health conditions experienced by Queenslanders. Asthma was the 4th most frequent chronic disease reported in Queensland (QLD).[11] Prevalence of asthma in Queensland was in average higher compared with other states, and geographically this increase coincided with coal mining areas and coal industry activities (coal power stations, coal transport corridors and coal ports). In 2017-2018, one in nine Australians had been diagnosed as having asthma.[12]

The Australian Institute of Health and Welfare's (AIHW) 2019 COPD report stated that COPD was the 5th leading cause of death in Australia in 2017, however the COPD reported on was classified as only the two lung diseases emphysema and bronchitis, and no other COPD disease such as pneumoconiosis were reported on.[13] Considering that the maps did not take into account pneumoconiosis as being part of the COPD figures, the actual numbers could be higher than recorded in the COPD report.

The cooperative research centre for developing Northern Australia (CRCNA) commissioned a report called Northern Australia health service delivery situational analysis, its draft for consultation was made public in October 2019. The report showed the incidence of COPD (2,796) and asthma (941) in Queensland as the highest reported in Northern Australia.[14] The prevalence of asthma was reported as higher for those living in Inner Regional or outer regional and remote Australia compared with people living in major cities. Additionally, in the National health survey: first results for 2017-2018, it was reported that COPD rates in Queensland were higher than other states, making up 3.4% of all chronic health conditions compared to 2.5% for the national average. Interestingly Queensland had a lower rate of adults who have never smoked compared with the rest of Australia (53.6%-QLD, 55.7% Australia).[11] While literature was available for respiratory health for Southeastern Queensland (in particular Brisbane and surrounds) a lack of literature for respiratory health for the regions of North Queensland, Central Queensland and Mackay, Isaac and Whitsundays would require further research to acquire such data from appropriate sources such as Queensland health.

PARTICULATE MATTER FROM COAL MINING

Particulate matter can cause chronic respiratory disease when PM_{10} and smaller (larger particles are trapped in the nose and throat effecting a natural filtration system) bypass this system and continues directly into the lungs. CMDLD is caused by coal mine dust, silica dust and asbestos being lodged into the lining of the lungs which causes scaring and lesions. Long term exposure to particulate matter can result in reduction of lung health and function, development of lung and heart disease and the acceleration of these diseases with the result being a reduced life expectancy. A National Institute of occupational safety and health (NIOSH, USA) study for the period 1996-2004 showed that 6,279 coal miners had died of CWP in the USA, which was in comparison to 230 fatalities caused by mining accidents.[15] A recent review of coal mining in the USA showed that the rate of pneumoconiosis including progressive massive fibrosis (PMF) continues to increase and among their response to the crisis was the implementation of continuous personal dust monitors and the implementation of a reduced exposure limit for respirable coal mine dust. However, the effectiveness of these measures on reducing prevalence of pneumoconiosis will take an unknown number of years to ascertain due to the long latency period of the diseases within the CMDLD spectrum.[15] The United States census industry code showed coal mining to be the highest risk industry for asthma and COPD related deaths and the results were independent from smoking as a risk factor.[16,17] A study by Hendryx and Entwhistle measured the association of living in close proximity to a surface coal mine in Indiana and West Virginia (within 3 miles of the mine) as opposed to living further away from the mine site on the levels of C-reactive protein (CRP) in the residents' blood. High levels of CRP predict increased risk of cardiovascular disease and poor lung function. Such high levels can be the result of smoking, obesity and environmental factors such as particulate matter from traffic or industrial sources. The results showed mean particle counts per cubic foot were higher for residences closer to mines than farther away.[18] Within the Australian context concerning the above scenarios the following data from The Australian conservation foundation (ACF) illustrates how coal mining and industries would be relative to the issue of PM emission and health. The ACF reported coal-fired power stations are the largest emitters in three (Hunter Region; Latrobe Valley and Collie) and mining operations created the most emission in the other two (Mount Isa and Newman). In addition, the 5 top polluting facilities recorded were: Mount Isa Mines-QLD -copper, lead, zinc and silver mining; Bayswater Power Station-Hunter Valley, NSW-coal-fired power station; AGL Loy Yan-Latrobe Valley, Victoria-Coal-fired power station; Nyrstar Port Pirie, South Australia-metal smelting and refining; Stanwell, Rockhampton, QLD-coal-fired power station.[19]

PREDICTORS OF LUNG DISEASE

Coal-fired power stations: As of 2019 coal accounted for 63% of total electricity generation in Australia.[20] There are eight coal fired power stations in Queensland, three within the geographical region of this study. They sit in Callide (near Biloela, Central Queensland), Gladstone (the largest in Queensland) and Stanwell.[19] Morrice & Colagiuri explore the air pollution, health and social issues emanating from these power stations and the emission of particulate matter of PM_{10} or smaller size from coal fired power stations has been identified as significant.[21] A report prepared by Malfroy, Cope and Nelson states in regard to New South Wales coal-fired electricity stations that modern industrial particulate collection systems are very effective in removing course particles from exhaust gases of facilities however there are some that are less so in terms of effective removal of finer particles.[22] Also, unless flue gas scrubbing is used the possibility for secondary particles forming from sulfur dioxide and nitrogen oxide emissions exist. Therefore, coal-fired electricity generation is a potentially significant source of fine particles emission due to ash particles which can pass through the collection systems and the formation of secondary particles from the emission of sulfur and nitrogen oxides.

RAIL TRANSPORTATION OF COAL

As per British Petroleum (2018) Australia is the third largest coal producer and largest exporter of coal in the world. In another source it was reported by the International energy agency for 2016 that Australia was the second largest exporter of coal in the world and ranked 5th in the exports of gas, oil, and coal globally.[23,24] These figures give an indication of the large-scale transportation of coal from mine sites to coastal ports for export and therefore the coal dust and particulate matter that by reason would be in the air and surrounding proximity to the railway corridors used.[20] Four of the seven coal ports within Australia are located in Queensland and three of those are between just north of Bowen and Gladstone, the fourth being the port of Brisbane.

SMOKING

The progressive nature of COPD regardless of treatment and or preventative measures whilst continuing to smoke has helped to confuse the spectrum of CMDLD with

COPD. This confusion helped to perpetuate the belief that smoking was an equal partner to coal dust exposure in the causation of CMDLD and its progressive nature as it is with the COPD. An early British paper by Elmes illustrates this previously accepted theory by stating that 'evidence' showed that dust within the coal mining and steel industry contributed little to causing death within the workplace compared with smoking.[25] Additionally, Wada stated that smoking related to pneumoconiosis by promoting the disease, aggravating the symptoms of pneumoconiosis, creating difficulty in correctly diagnosing chest X-rays and increasing the incidence of pneumoconiosis lung cancer.[26] However, in a German study women aged 55 were tested for COPD and pulmonary function considering their place of residence where a group lived in close proximity to busy roads, showed that PM and NO in conjunction with living near a busy road were the defining factors in the presence of COPD and declining pulmonary function.[27] They repeated analysis on smokers and non-smokers and the symptoms including COPD were shown not to change substantially. This was mirrored in a Swiss study (on air pollution and respiratory diseases in adults) where the effect of PM was equal on both smokers and non-smokers. Sources of PM and PM include construction sites, unpaved roads, and smokestacks/fires; however, particles will also form as a result of pollutants emitted from power plants, industrial processes and automobiles.[28] Details of the methodology is provided in the supplementary document, appendix S1. As there is limited information, we conducted a scoping review to identify any available literature and data concerning the Queensland coal industry and its effect on respiratory health of miners, mining related workers and communities in proximity to coal mines.

RESPIRATORY DISEASE LINKS TO COAL EMISSIONS

A study by Hendryx, Luo, Chojenta & Byles investigated the risk of COPD incidence and prevalence when compared to areas of demonstrated air pollution. They did this by merging the Australian longitudinal study on women's health with point pollution emissions data from Australian' National pollutant inventory. In doing so they were able to compare multiple sources of pollution as well as five air pollutants (CO, NOx, SO_2, $PM_{2.5,}$ and $PM_{1.0}$) to a large population and age range, in this case three cohorts of women born during the years 1921-1926; 1946-1951 and 1973-1978. The results from the study showed that women without baseline COPD where at greater risk of developing COPD over a 20-year period if they lived in proximity to multiple sources of pollutant air emissions, this risk increased inversely within 10kms of residence and pollution source. The pollution sources in the study were from various industries and all contributed to air pollution and increasing the risk of respiratory disease, with exposure to the top five emission sources of the measured pollutants carbon monoxide; oxides of nitrogen; $PM_{10;}$ $PM_{2.5}$ and sulfur dioxide.[29-33]

GEOGRAPHICAL AND SOCIAL SCOPE OF COAL EMISSIONS

In their 2015 article on Ultrafine particles over Eastern Australia: an airborne survey, Junkermann and Hacker reported that coal fired power stations inland between Brisbane and Rockhampton were identified as major sources for ultrafine particulate matter (<100 nm); a high proportion of coal fired power stations within Queensland are located in regional Queensland. Particles in the ultrafine category can have a lifetime of a few hours to a week and in this time can travel over a hundred kilometers.[34] In regards to the dispersion of pollutants from these emission sites modelled buoyant elevated sources for both inland and coastal coal fired power stations of Queensland were observed by Best and Stümer.[35] The sea breeze and its deep inland penetration and the geographical terrain are important factors in how far pollutants will travel from emission sites. It was stated that the worst-case meteorological scenarios for impact of air pollution from coal-fired power stations in tropical regions of Australia is caused by the convective, sea breeze states. Hendryx, Islam, Dong and Paul expanded on community air pollution exposures to include occupational exposures. They explored the underestimation of total pollution exposure to coal miners, who during working hours are obviously exposed to particulate matter associated with coal dust but who are also exposed outside of work hours with community exposure in regard to their residential proximity to coal mines.

The respirable coal dust associated with coal mining, both surface and underground mining, contains quartz silica, phyllosilicates and sulfides which can lead to respiratory cell damage. The total emissions were used, that is both the point emissions and fugitive emissions. Point emissions are released from stacks, vents and any other deliberate emission device. Fugitive emission come from leaks in equipment, handling or other industrial processing procedure as well as environmental factors such as wind.[36]

EARLY DETECTION OF FIBROTIC LUNG DISEASE SUCH AS COPD AND CMDLD

Interstitial lung abnormalities (ILA) are a term for asymptomatic minor interstitial changes that don't fit into existing diagnostic categories. At the time of the study the significance of ILA wasn't clearly defined, however other studies found reduced health, reduced lung function and increased risk of pulmonary fibrosis specific mortality to be associated with ILA.[37] This study introduces the possibility that presence of ILA could represent pre-clinical fibrotic lung disease, providing a useful tool for further study into fibrotic lung diseases such as found in the spectrums of COPD and CMDLD.

The current latency period for lung diseases fibrotic in nature can be substantial, so by the time the patient has symptoms, they have a developed lung disease. However, if ILAs are identified within vulnerable sections of the community, or industries associated with high risk of contracting a respiratory disease, there would be the opportunity to identify a pre-clinical fibrotic lung disease.

FACTORS CONTRIBUTING TO CMDLD

In 2016 a paper by Zosky et al in the medical journal of Australia discussed the causes of CWP and the re-emergence within the Australian coal mining industry. They found with the recent reports in Queensland and studying international data that there was a resurgence of pneumoconiosis. There were a number of potential reasons for the re-emergence of CWP including changes in the physiochemical characteristics of the dust. Properties of processed coal include organic and inorganic contaminants with pro-inflammatory and carcinogenic properties such as silica, iron, cadmium, lead, kaolin, pyrite and polycyclic aromatic hydrocarbon. Inflammation of the lung and the formation of fibrosis in response to the dust particles causes the type of lung disease found in the CMDLD spectrum. In addition, crystalline free silica is found in large quantities is coal mine dust, this can also cause silicosis, therefore creating a significant overlap with CWP. The amount of dust and composition of that dust determines the emergence of CWP, and it can vary significantly between individuals, which has in the past complicated correct diagnosis.[38] Underground coal mines in Queensland are mostly Longwall mining, which involves a rectangle shaped portion of the coal face being shaved by giant cutting drums to produce a slab of coal (CSIRO, 2020).[39] This form of mining has been thought to produce 3-4 times more dust as other methods of mining such as continuous mining due to its high speed production rates and bi-directional cutting.[40,41] The misconception that only underground coal miners were in danger of contracting a CMDLD prevailed until proved incorrect with one of the very public cases in the resurgence of black lung to be found in Queensland above-ground miners. In 2010 NIOSH included surface coal mine workers lung screening to enhance their surveillance program which previously just tested underground coal workers.[42] Queensland's first case of black lung in an above ground coal miner was confirmed by DRNME as being among the resurgent cases of CWP since 2015.[43] The Monash review of the respiratory component of the coal workers' health scheme addressed this as a recommendation for amendments to assume both underground and open-cut (above ground) miners were both considered at risk of contracting CWP through coal dust exposure.[44] At the time of writing their paper there had been no standardization of coal dust exposure limits within Australia and the different states varied in their accepted levels of dust exposure for coal workers. Queensland's coal mining safety and health regulation 2017 had mandated an average occupational exposure level for respirable coal dust as 2.5 mg/m³ air for an 8-hour period, and 0.1 mg/m³ air for respirable crystalline silica in an 8-hour period (as calculated under the Australian Standard 2985:2009).[45]

IDENTIFICATION OF CMDLD

In 2018, McBean, Newbigin, Dickinson & Edwards wrote a review to provide a description of radiological features when using high-resolution computed tomography (HRCT) of CMDLD. This was in response to the resurgence of black lung within the Queensland coal mining industry and the lack of expertise in reading x-rays in relation to understanding the signs of early CMDLD and the fact that they can only be caused by coal dust rather than other lung diseases such as emphysema and chronic bronchitis which can also be caused by other factors such as smoking. In their paper they described the spectrum of CMDLD, which included silicosis, coal worker's pneumoconiosis, mixed dust pneumoconiosis, progressive massive fibrosis, and dust-related diffuse fibrosis. This was an important reference for the Australian medical and coal mining industry as it explained the not only the visual aspects of how each of the diseases present, but added to the literature on HRCT, which at the time of their paper was sparse, as traditional chest X-rays had been the most common tool for distinguishing CWP.[46] McBean, Tatkovic, Edwards and Newbigin then undertook a case series in 2015 after pneumoconiosis re-emergence in the Queensland coal mining industry to understand the radiological presentation of CMDLD for accurate diagnosis.[47] They viewed chest radiographs and high-resolution computed tomography (HRCT), they classified the radiological findings with the International labor organization (ILO) classification system and the HRCT with the international classification of HRCT for occupational and environmental respiratory diseases (ICOERD). There is a wide spectrum for occupational lung diseases with many variations and crossovers of diseases and presentations, and that was indicative with this study. Emphysema with no zone dominance was the key radiological feature in those with COPD. The grading of the abundance of opacities on chest radiograph follows across a 12-point scale (0/0 to 3/+), and the higher the grade the higher the likelihood of lung impairment and developing of PMF. The ICOERD is used to grade the abundance of opacities, inclusive of round, irregular and ground glass opacities, as well as emphysema, across a separate 19-point scale.

This case study was the first look at CMDLD in Queensland since the 1984 review by Rathus and Abrahams, which identified 33% of the 7,784 viewed radiograph images as having an ILO≥ 2/1.[48] It was noted that only a small number of international studies had similarly high rates of CMDLD and most of the factors that would account for these rates did not apply in Queensland mines heightening concern regarding the prevalence rates witnessed. A consistent factor that would be attributable to the Queensland cohorts would be the evidence of high percentages of respirable crystalline silica (RCS) present which recognized as more hazardous than coal dust alone and associated with higher grades of disease and faster progression of lung disease towards PMF. These observations make clear the urgent need for the establishment of accurate levels of occupational health surveillance and reporting to a national data base to ensure correct data of the prevalence of any CMDLD and relating factors are recorded for the health of past, current and future coal miners not only in Queensland, but Australia.[47]

OCCUPATIONAL RESPIRATORY SURVEILLANCE

In 2017 McCall wrote a report for Lancet with a personalized account of Queensland coal miner Garry Suhle to illustrate the very real and personal side of the re-emergence of CWP, the legacy of misdiagnosis and its long-term health implications. In a telling interview with Garry, he mentions the fact that a lot of the older men he worked with had died at a relatively early age (in their 60’s) with what was diagnosed in the recent past as emphysema, however given the re-emergence of ‘black lung’ it seems quite likely that they had CWP or a variation of it as represented in the spectrum of CMDLD as known today. Whilst working as a coal miner in the past he had a chest X-ray that showed he had silicosis, there was no follow up and no action taken, highlighting the failings of the occupational health and safety programs of the past. The article acknowledges the difficulty of correctly diagnosing a CMDLD through chest X-ray and requires medical staff to be specifically trained in the internationally accepted protocol.[49] Wood and Yates re-iterate the situation further with their paper on distinguishing respiratory surveillance from population screening and case finding.

They acknowledge that dust-induced lung diseases are complex and require a high level of understanding of non-occupational as well as occupational factors when assessing a patient and that current tests used in respiratory surveillance lack sensitivity and specificity. Designing a robust respiratory surveillance program is challenging as there is not a stand-alone test that can accurately identify early lung disease due to the fact that several types of lung disorders may occur with the same exposure history. They argue population health screening as used in the process of testing healthy population to identify risk factors or early disease such as cancer is not appropriate for occupational lung surveillance. In addition, case finding which investigates disease outbreaks and uses traces to identify potential candidates who may have been at risk for contracting a disease has been used in the occupational setting of the artificial stoneworkers who have been at high risk of contracting or already having progressive silicosis. The term respiratory surveillance is being used to describe the process of early detection of disease with workers classified as at risk such as stonemasons. It includes tools such as quality questionnaires, spirometry, and X-rays.[50] Each aim of this literature review proved challenging for due to the limited number of papers researched and published on these three fields. Aim one was perhaps the most difficult as there was no correlating information for the geographical regions being examined, however there were a number of papers addressing the respiratory health of the residents of Brisbane.

There were statistics available through AIHW and ABS for Queensland, however not for the separate regions within, although there were statistics for public hospitals that addressed the type of disease presented at the emergency department of Queensland hospitals and if they required admission to hospital, there was no further breakdown of the regions of Queensland these numbers represented. There was also statistics regarding the residence of patients that presented and were categorized under: Major cities, inner regional, outer regional, remote and very remote, again there were no State and regional breakdowns to indicate which part of Australia they represented.

To gain more detailed and relevant data it would be necessary to obtain Queensland Health records on public hospital presentations, admissions, disease identification and place of usual residence from the emergency departments, admitted patients, non-admitted patients and death register to be able to analyze and synthesize information relevant to the first aim of this literature review. Although there has been a great deal of literature on this subject globally to date there has been little research for the Australian context of the situation, and none for the regions of Queensland being addressed in this review. Information for this aim of the review relied upon data from the National Pollution Inventory to try to make connections with the Queensland regions associated with coal mining and related activities.

However, the Hunter region of New South Wales has conducted research in relation to the question of the health effects of the coal industry on residents in close proximity to mines, transport corridors and ports. The Hunter region could be used as an example of the type of studies needed to establish similar information regarding the coal industry regions of Queensland. To date there has been very limited research into the underreporting of CMDLD amongst the coal mining workers of Queensland. With the advent of the re-emergence of CWP in the Queensland coal mining industry there is little doubt from experts in the field of occupational health that there will be additional cases coming to light in the future, which will have been a result from inadequate surveillance and testing in the past. However, at this stage due to the past system in place for workplace health respiratory disease reporting and following up there will most likely be a misalignment of diagnoses as well as misdiagnosis and underreporting. Legislation is evolving to rectify the past errors concerning occupational disease surveillance and acknowledgement as well as better screening and expertise in the area of disease identification. However, due to the nature of

CMDLD it needs to be identified early to be able to halt its progression by removal from the environment that caused the disease manifestation in the first instance and or treatment to ensure morbidity from the disease does not ensue at a premature rate.

Research and study needs to be conducted for this third aim as a matter of not only treating workers who have fallen through the crack for various reasons (underreporting, misdiagnosis, change of jobs, retirement, etc.) but to establish correct data on the prevalence rate for CMDLD in relation to Queensland coal mining to ensure the eradication of a preventable occupational disease that should have stayed part of the history of coal mining and not precursor to current standards of occupation health amongst coal workers.

CONCLUSION

Information gained from the limited literature illustrates evidence of high-level pollution emissions from the coal industry in the state of Queensland, the combination of toxic emissions and high PM levels in areas where not only the workers within the industry would be affected, but also the residence of these communities have far reached public respiratory health implications. Further study and research need to be conducted to collect robust data concerning pollution emissions, PM levels and health effects on the general community through air quality testing, hospital data and community testing and surveillance to gain a true insight into health effects and prospective health effects to communities that live and work in coal mining areas.

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