

# **A Clinical, Radiological and Occupational Review of Coal Mine Dust Lung Disease in Queensland**

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## The Problem

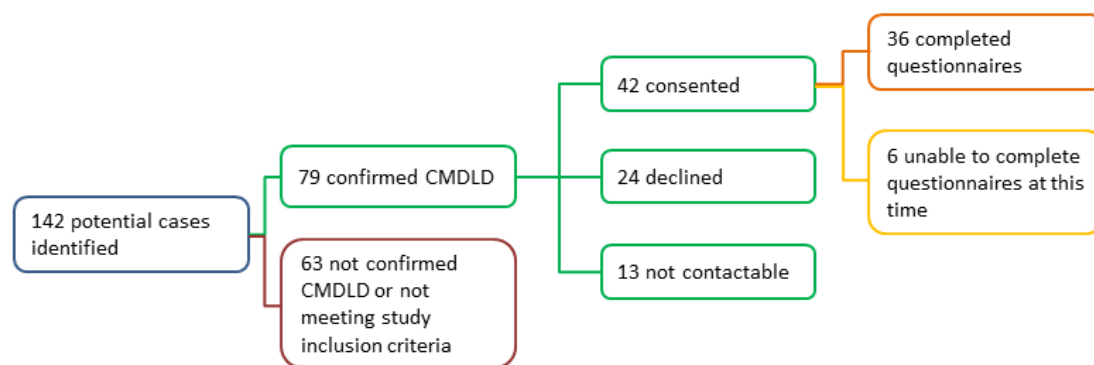
Coal mine dust lung disease (CMDLD) is an umbrella term for occupational lung diseases resulting from dust exposure during employment in the coal mining industry. Coal mine dust includes carbon, quartz and silica particles which, when inhaled, can lead to a range of pathological changes in the lung. One form of CMDLD is pneumoconiosis which is a term for diseases associated with inflammation, fibrotic scarring and cell death of lung tissue. Coal workers' pneumoconiosis (CWP), mixed dust pneumoconiosis (MDP) and silicosis are the three most common forms of pneumoconiosis associated with coal dust. Tissue scarring in pneumoconiosis can be seen on medical imaging as opacities ("shadows") or nodules obstructing the normal lung structure. In advance cases of pneumoconiosis, the nodules can merge together, forming large areas of fibrosis called progressive massive fibrosis (PMF). Some CMDLDs are not associated with fibrotic nodules and these include dust-related diffuse fibrosis (DDF) and chronic obstructive pulmonary disease (COPD).

In 1984, Doctors Rathus and Abrahams performed a review of the health of coal industry workers in Queensland identifying that approximately 1% of workers had abnormal chest radiographs with characteristics consistent with pneumoconiosis [1]. Since this review in 1984, CMDLD was thought to be eradicated for 30 years. Conversely, CMDLD was undetected for these 30 years, with the first cases being re-identified mid-to-late 2015. In 2016 when this research project commenced, Queensland was unaware of the health status of their coal industry workers. For example, once re-identified, it was unknown which CMDLD were present in the population, the severity of these diseases or the occupational histories of those impacted.

## The Solution

When the re-identification of CMDLD occurred in 2015 an opportunity for a research project was identified. Doctors working in the field (for example respiratory physicians) did not know what to look for when assessing workers for CMDLD because they hadn't seen it before. Medical professionals are vital to the screening, diagnostic and patient management pathways, so it was important to educate the medical community on CMDLDs. Additionally, due to the extended period of time since Rathus and Abrahams reviewed the health of coal industry workers, it was important to understand and update the medical and mining industries on the current health status of workers in the coal mining industry.

We set out to complete an in-depth review of positive CMDLD cases identified in Queensland coal industry workers since 2015. Our specific research aim was to clarify the current spectrum and severity of CMDLD observed in Queensland. This involved identifying and retrospectively reviewing confirmed CMDLD cases. We were notified of positive cases either by a treating respiratory physician or the Department of Natural Resources, Mining and Energy (DNRME). A total of 79 cases were identified as positive for CMDLD. For each individual, we reviewed medical imaging, including chest radiographs and high resolution computed tomographs (HRCT), and medical charts to retrieve occupational history and lung function testing results. The flowchart below describes the process of case identification in our study.



In addition, we created a questionnaire to prospectively gather further information. The purpose of this questionnaire was to record in-depth occupational history and details on respiratory health and symptoms. The questions used to record occupational history incorporated roles and Similar Exposure Groups (SEGs), as classified by the DNRME, and was created in collaboration with occupational health professionals and occupational hygienists. The questions used to gather respiratory symptoms involved three internationally-validated questionnaires; the Medical Research Council (MRC) Questionnaire, Modified MRC Dyspnoea Scale (0 to 4) and the Clinical COPD Questionnaire (CCQ). The MRC Questionnaire was used to assess respiratory symptoms, smoking status/history and previous illnesses. The Modified MRC Dyspnoea Scale was used to grade and classify impairment due to breathlessness. The CCQ was used to understand the quality of life of each individual from a health-related perspective. To conduct the questionnaire, a member of our research team met with the consenting individuals with CMDLD to complete the questionnaire. When this was not possible, an electronic copy was sent to the participant. In total, 36 participants were involved in the questionnaire portion of the study.

## Benefits/Effects

### *Clinical Results*

The study group consisted of 79 individuals, who were all male with a mean age of 59 years (range: 35-90). Our study showed, of the 79 positive cases that were reviewed, pneumoconioses were diagnosed in 71% of subjects (n= 56) with CWP being the most common diagnosis (n= 27). Other forms of CMDLD were present in 29% of subjects (n= 23) with COPD being the next most common diagnosis. On medical imaging, 19 subjects were classified as having advanced disease, including

six cases of PMF. The proportion of individuals with normal and abnormal lung function was very similar, with 34 individuals having normal lung function results and 38 having abnormal results. Disease severity, as assessed by lung function, ranged from normal to severely abnormal.

### *Occupational Results*

The study group had varying employment tenure in the coal industry (6-45 years) with an average tenure of 26 years (available for 74 subjects). Our study group reported a large range in the year they started in the coal industry, with start years from 1955 to 2008 reported. 44% of participants had worked only in underground mining, compared to 27% who had never worked in underground coal mines (including two coal port workers). The remaining 30% had worked in both mine types. The majority (74%) of participants worked in the Queensland coal industry alone, without any interstate or international coal industry employment. 11% reported also working in interstate coal industries and 15% reported working in coal industries outside of Australia. 27% of subjects had a period of employment in mining outside the coal industry including hard rock mining and/or quarry work.

### *Prospective Data*

Of the 36 participants who completed prospective questionnaires, 29 participants reported they were symptomatic (80%) with cough being the most common symptom reported by 75%. 26 reported breathlessness (72%). 32 participants (89%) reported a total score of 1 or higher on the CCQ, indicating they experience some impairment of quality of life.

The subjects who participated in the prospective component of this study reported a cumulative total of 918 years employed by the coal mining industry. To divide according to SEGs categories, 18 individuals had worked in underground coal mines, 17 in open-cut coal mines and 1 in a coal handling and preparation plant (CHPP). The most common SEG reported by this group was Development Production (n= 19), an underground role. The second most common SEG was Dragline, an open-cut mine role.

Previously, both the medical and coal mining community did not understand the health status of Queensland coal industry workers. We conducted an in-depth review of 79 CMDLD cases and reported their diagnoses, respiratory health, medical imaging findings, symptoms and their occupational history. The information we collected demonstrates the range of diseases, clinical features, symptoms experienced, employment tenures and roles and mine types that contributed to a CMDLD diagnosis. Ultimately, we hope these findings will boost awareness of CMDLD in the medical and mining communities in Queensland.

### *Transferability*

With the completion of this research project, we reported the outcomes/findings of this project to stakeholders. This involved submission of a comprehensive report to the Queensland government (DNRME) and industry body (ACARP) who jointly funded this research.

In addition, we anticipate that our update on the health status of coal industry workers can be transferred to mining companies via local doctors, nominated

medical advisers and the DNRME. We have already submitted three conference abstracts to both mining and medical conferences, in an effort to inform the relevant audience of our findings. We will also publish our findings in a relevant peer-reviewed medical journal (submitted and under peer-review as of May 2019) to inform the wider medical and research communities of our important findings. We hope to conduct further research in this space to continue to boost the health and safety of Queensland coal industry workers.

To conclude, our methods and results will have broad exposure to the resource industry particularly through our conference submissions and we hope that our medical journal publications will reach this audience too. Our methods aimed to understand the health of coal industry workers and this method can be transferred across the resource industry. We hope that the value of our methods will be recognised by other industries and will be repeated within these, to understand the health of workers in other dusty industries.

#### Approximate Cost

Our project was jointly funded by ACARP (\$119,600) and by the Queensland Government DNRME (\$196,170), with further in-kind support from UnitingCare Medical Imaging.

The research funding received covered costs associated with the employment of research staff, development of the questionnaire (inclusive of software), travel to rural/remote areas to complete questionnaires, and overheads (inclusive of office rent).

These costs were spent over the two year period, covering the start of the project through to completion. There are no future costs as this project is complete.

#### References

1. Rathus, E.M. and E.W. Abrahams, *Chest x-ray and emphysema check survey of colliery employees in Queensland*, in *The Queensland Coal Board Coal Miners' Health Scheme*. 1984: Queensland.